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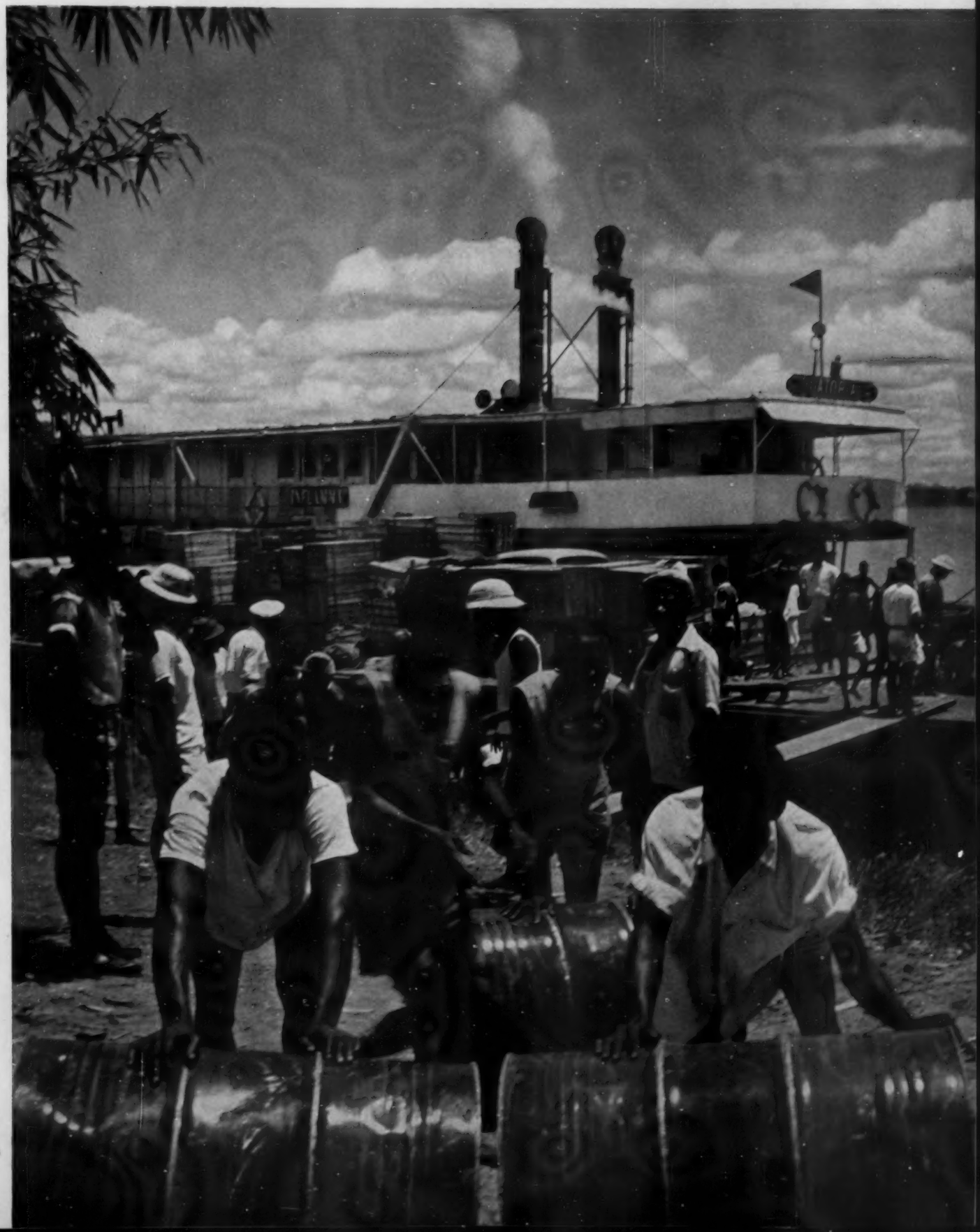

UGUST 1956

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THE NEW CAMERON "CA" CASING HANGER LETS YOU

Hold Everything!

Hold Heaviest Casing Loads Without Crushing Pipe

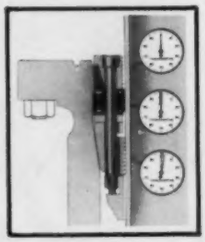
Hold Lightest Casing Loads, Yet Seal High Pressures

Here is a truly remarkable improvement in casing hanger design . . . the result of years of experience in casing suspensions and seals coupled with a determination to produce a hanger that combines the best features of present designs, yet eliminating many objectionable features and limitations.

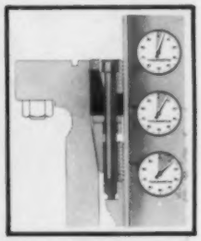
The "CA" Hanger is interchangeable in all regular Cameron casing heads. It is fully automatic in operation and can handle pipe loads to joint strength without damage to the pipe. On the other hand, its self-energizing resilient seal is so efficient that it effectively and automatically seals off highest pressures even though the casing load may be extremely low.

Hold everything . . . until you have inspected this new hanger. Better still, order one now for your next casing string.

The "CA" Hanger — wrap-around design, automatic setting and sealing; interchangeable in all regular Cameron casing heads.



Even under lightest casing loads, self-energizing resilient seal effects pressure-tight packoff.



Extreme casing loads result in only minimum deflection in pipe. Yield strength of pipe is not exceeded at joint strength.

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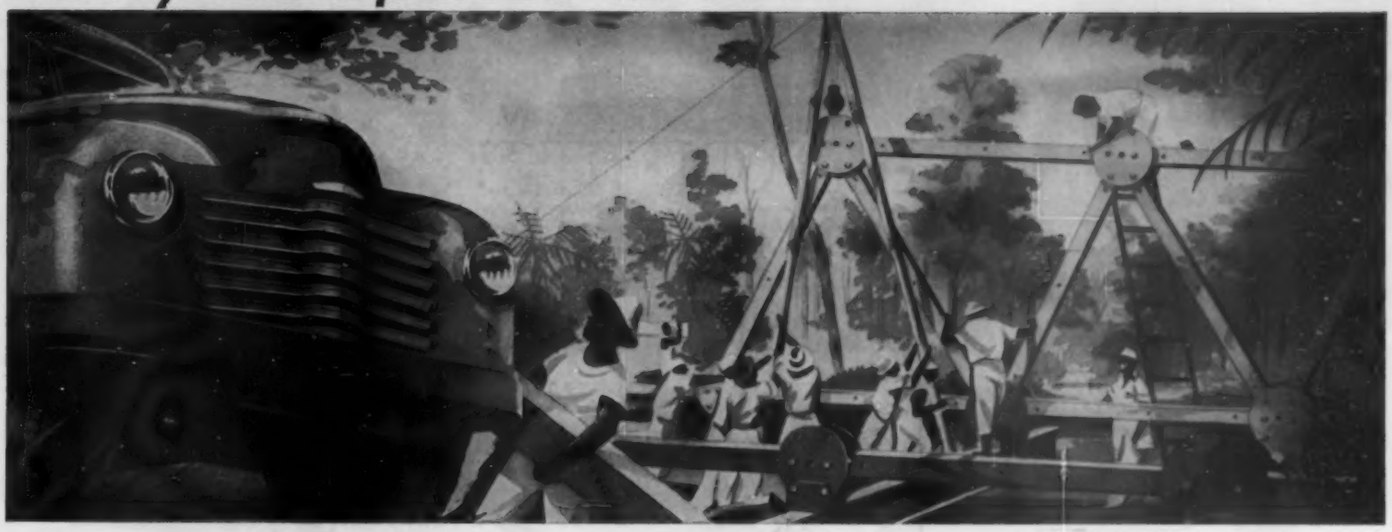
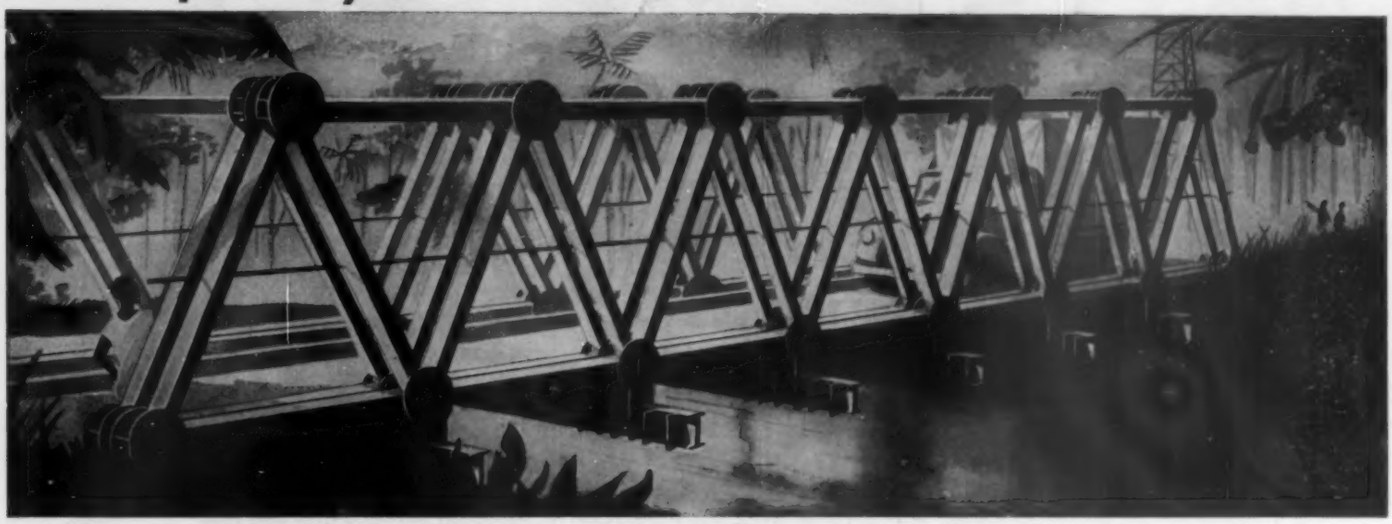
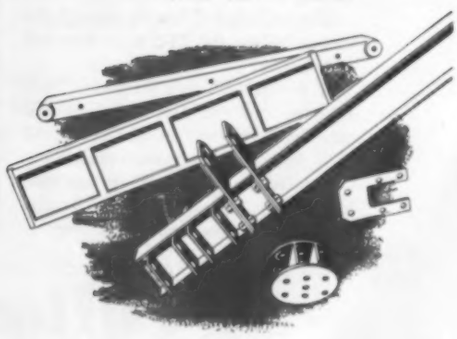


and quickly erected on . . .



remote up-country sites

Butterley Standard-Unit Bridges are in use all over the world where transport is difficult, skilled labour scarce or where site preparation has to be carried out under adverse conditions. From five standard units, all sizes of bridges can be built; the units can be sent by any form of transport; site erection is remarkably simple and swift with an absolute minimum of equipment.



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McCullough Log Enables Precision Perforating of 5′ Pay Zone

Discovers 8′ Error in Electric Log and Casing Measurements

Operator of this old well ran an electric log which located a new, possibly productive, 5′ sand.

McCullough was then called to run a Neutron Log. The Neutron curve confirmed the productive possibilities of the new zone, but also discovered that both the electric log and casing measurements were 8′ in error.

The well was plugged back to 6800′ and perforated according to McCullough measurements.

Thirty ½" improved Ogival Bullets were shot in the 5′ sand in one run by a 3½" O.D. McCullough M-3 Gun. Casing was 5½" O.D. 17 lb.

The well started flowing through the casing before the M-3 Gun was out of the hole.

If the McCullough Radiation Well Logger had not discovered the 8′ measurement error, the 30 shots would have missed the pay zone entirely.

It always pays to rely on the accuracy and dependability of McCullough's Radiation Well Logger.

McCullough Log Locates and Defines 11 New Pay Zones

Accuracy of McCullough Radiation Well Logger Permits Sharp Shooting of 11 Thin Zones for 138 B/D Increased Production

This was an old well in an established California oil field. Production had fallen to five barrels of oil per day.

Believing better production was possible, the operator decided to log and re-perforate the well. McCullough's combination Gamma Ray-Neutron Log was run from 4380′ to 5645′, locating several small, promising stringers of untried sands above the original pay zones.

A simultaneous collar log accurately located casing collars in relation to these thin sands, thus assuring "pin-point" accuracy in perforating.

The two original producing sands were re-shot, four holes per foot, with 26 improved ½" Ogival Bullets from McCullough M-3 Guns and with 26 McCullough Standard Casing Glass Jets.

Above these zones were the 11 small sand stringers ranging in thickness from 4 feet to 13 feet. Intermediate zones, lying between the productive sands, which were not to be perforated ranged in thickness from 5 feet to 103 feet.

Accurate measurement means "putting the shots where they count"... and the "pin-point" accuracy of the McCullough Radiation Well Logger makes sharp shooting of thin zones practical... assures uniform perforating coverage of any zone, thick or thin.

The 11 pay sands were perforated with 256 shots, four holes per foot, by 3½" O.D. McCullough M-3 Perforators firing ½" Ogival Bullets. Production increased from 5 to 143 barrels of oil per day.

This is only one of many actual jobs where the accurate, reliable, easily interpreted information provided by the McCullough Radiation Well Logger has located and defined multiple pay zones, tied-in casing collar locations and permitted precision perforating for best possible production.

McCullough® TOOL COMPANY

Cable Address: MACTOOL

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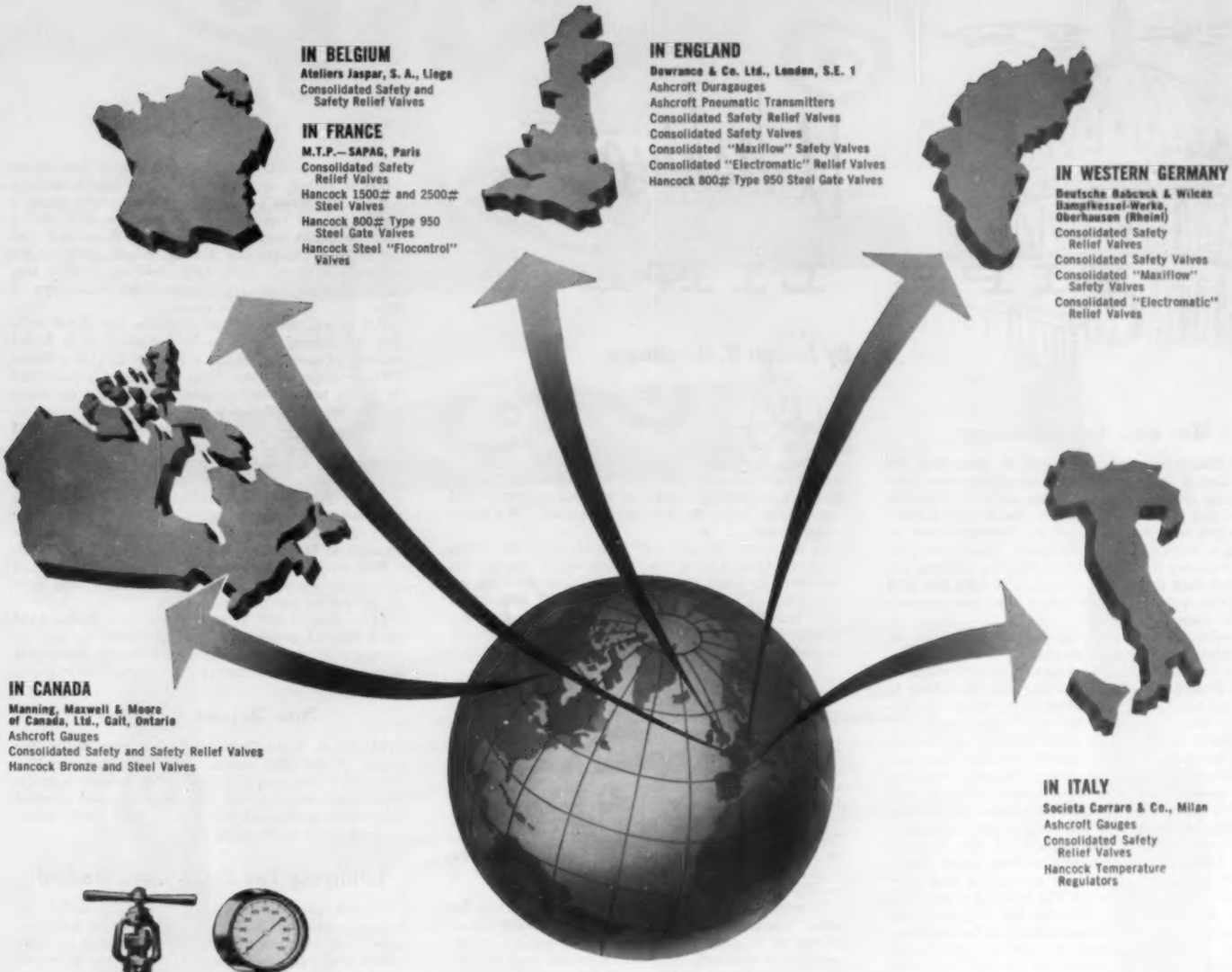

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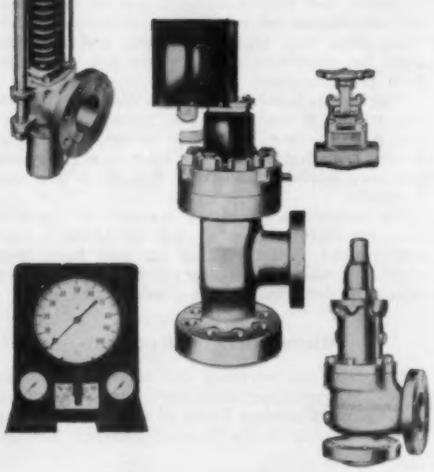

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Washington PIPE LINE

By Joseph B. Huttlinger

May Ease Gas Regulation

The Eisenhower administration is spreading the word that it will get behind legislation next year to ease up federal price and other controls over U.S. natural gas producers. Latest to speak on the subject is the new Secretary of the Interior Fred A. Seaton, a former aide to President Eisenhower. He told a reporter in an interview that the chances are excellent that the administration will take the lead next year and restate its views that the controls must be eased up.

"Freedom of producers, as well as protection of the public is necessary," he said.

Some time ago, Dillon Anerson, a special assistant to the President, told a meeting the President is for a gas bill to help the producers. "It is the position of the President," he said, "that legislation conforming to the basic objectives of the Harris Bill is needed, that it is needed because the type of regulation of natural gas producers required under present law will discourage initiative and incentive to explore for and develop new sources of supply. He made that clear in his veto message."

Chairman Jerome Kuykendall of the Federal Power Commission, has been calling upon independent producers, pipe line companies and distributors to get together on the form of a new bill to ease up the present controls. He expressed his confidence, "that agreements arrived at in consideration of the public interest as well as enlightened self-interest, will be acceptable to and approved by Congress and the President."

The statements are based on the assumption, naturally, that President Eisenhower will be elected next November for another four years in the White House.

Any new gas bill will face a stiff fight and Congressmen who supported the gas bill that reached the White House early this year, are reluctant to go in for another bruising battle. Within the industry, there is a feeling that any new try at a gas bill might be for a measure to set forth the manner of price and other controls over natural gas producers. They are not sanguine about the chances for legislation as good as the Harris Bill, which went further in the direction of removing the present federal controls.

The election of a Democrat to the White House in the November ballotting, would create a different picture entirely. As it stands, there is no Democrat among the front contenders for the nomination who is heartily in favor of easing up controls. In fact, all the Democrats in the running for the Presidency lean toward controls over gas to protect the consumer.

"Inferior Use" for Gas

The use of natural gas for "inferior" uses, such as boiler fuel, is a subject of prime attention at the Federal Power Commission. Although the FPC is yet to come to a firm policy, it obviously is trying to slow down use of gas under boilers—where coal can do the job.

In a case involving Northern Natural Gas Co., Omaha, the commission ruled last March, that sale of gas under boilers would be forbidden. On July 2, the commission changed his mind in a three to one decision, but did not make clear its reasons for change.

About the same time, however, the commission gave its views on the subject in a case involving Panhandle Eastern Pipe Line Co. "There is no boiler fuel use proposed by Panhandle and thus we are not approving a type of use for export which we do not favor for domestic purposes," the commission said.

A court test of "end use" controls is in the offing. National Coal Association, which wants the market Northern is after, is asking one more hearing by the FPC—a third hearing. The coal association says frankly it will take the commission into the courts, if necessary, to try to win a firm ban against use of gas under boilers.

Favors Unlimited Canadian Imports

The U.S. relies on Canada as a source of crude oil in time of war as well as peace, according to Dr. Arthur S. Flemming, defense mobilizer. He told a Congressional committee why he allows Canadian oil to come to the U.S. without limit under the new program to slow up imports to the U.S. "We concluded," he said, "that it was desirable to have the Northwestern part of the nation in a position where it could rely on Canada for a readily accessible source of supply."

Allowing in the Canadian oil without limit, he says, "recognizes our reliance on Canada as a source of supply for crude oil in a period of an emergency and reflects a desire on the part of our government to do nothing at the present time that would discourage the development of this easily available source of supply."

Dr Flemming came before the House Armed Service Subcommittee to explain why he was refusing government financial aid for the construction of a crude oil pipe line from West Texas to the Los Angeles area.

One reason there has been no emergency need for the crude line, Dr. Flemming explained, was: "A pipe line from the Canadian oil fields to the Pacific Northwest was in operation and capable of transmitting 103,000 barrels a day to U.S. refineries with current pumping facilities and up to a maximum of 250,000 barrels a day by installing additional pumping facilities on the line."

Dr. Flemming said the crude reserves of Canada are ample for the line, and that "all crude requirements of refineries in the Pacific Northwest could be met from this source."

Road Construction to Boost Demand

The American petroleum industry stands to increase its sales as a result of the huge, new road bill. One estimate is that in 10 years, there will be 30% more autos on the highways and that each will travel more miles.

In the long study of the bill, oil men suggested features to add to the bill. Among those adopted: (1) Free competition, contrasted with monopoly, is provided for gasoline and service on much of the 41,000-mile interstate system. (2) All road users will pay the 3-cent federal tax rate for gasoline but non-highway users may apply to the U. S. for a 1-cent refund.

The new taxes in the bill, which went into effect July 1, 1956, are designed to bring in $38,498 million over the next 16 years. Of this, $14,814 million is from the new and higher taxes.

The new taxes: Gasoline and diesel fuel—three cents a gallon, up one cent; Tires—eight cents a pound, up three cents; Camelback—three cents a pound, a new tax; New trucks, busses and truck-trailers—eight and ten percent, up three and two percent; Highway use tax on trucks over 26,000 pounds—$1.50 for each 1,000 pounds, a new tax; Auto tax—stays at 10%; Inner tube tax—stays at 9%.

All in all, the road bill provides for 27,839 million of federal funds to be matched with $5,301 million of state funds for a total of $33,140 million. This is over 13 years. This spending is supposed to be on top of normal spending, largely by cities and states, of well above this level.

While oil men, generally, accept the three cent tax rate, on top of state taxes—to seven cents, they plan to ask changes in tax provisions next year.

They want: A refund of the federal tax paid on gasoline lost by fire or flood; the tax due when the jobber sells the gasoline, not when the refiner sells it; a two percent evaporation allowance estimated at $15 million a year.

President Eisenhower, meanwhile, has come out against financial aid to gasoline dealers who may be by-passed by new highways.

In vetoing a bill to pay $6,000 to a dealer hurt by a federal project, he said it would be just as "reasonable" to expect those who benefit from new highways to pay the government part of their gains.

New Report on Chile

The U. S. State Department has received a few copies of the 1955 annual report of Empresa Nacional del Petroleo, the Chilean petroleum agency. The report covers crude oil production and refining operations, geological and geophysical work, value of production and sales.

Lobbying Tax Deductions Studied

An old question is up for study by the U. S. Senators once again: It is, is spending for lobbying deductible for income tax purposes? Every individual and very business in the country is interested in the answer. The question arises as the Senators study spending for and against the big natural gas bill that cleared Congress this year and ran into a veto at the White House.

The Internal Revenue Service is plain enough about the matters. Its regulation on the subject reads: "Sums of money expended for lobbying purposes, the promotion or defeat of legislation, the exploitation of propaganda, including advertising other than trade advertising, and contributions for campaign expenses are not deductible from gross income."

The fact is, however, that IRS does not stick to this ruling. It uses, often, a "principal purpose" test. And whether it admits it or not, IRS acts as if some spending for lobbying were an ordinary and necessary business deduction. But the whole area is cloudy.

The Senators are studying new laws on the subject,—for clarification—but this would be a next year project. It they go in for new laws, they might also make contributions to the Senators' own campaigns deductible up to certain limits.

Microfilm for Refiners

For excise tax purposes, the oil refiner can get by with microfilm records in part, but he must keep the original of general books of account, according to a new ruling by the Internal Revenue Service.

Productivity Rise in Refining

The U. S. Census of Manufacturers reports that the value added by refining at the nation's plants was $1,494 million during 1947; by 1954; it was $1,892 million, an increase of more than 25%. The number of employees increased from 146,000 in 1947 to 154,000 in the base year, 1954. Detailed figures will be along at the end of the summer.

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SOON, OUR NEW AUTOMATIC SEAMLESS STEEL PIPE MILL, NOW NEARING COMPLETION AT SAULT STE. MARIE, ONTARIO, WILL BE IN PRODUCTION. DESIGNED PRIMARILY TO SERVE THE OIL INDUSTRY, ITS MAIN PRODUCTS WILL BE SEAMLESS OIL-WELL CASING AND LINE PIPE.

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INITIAL CAPACITY WILL BE 225,000 TONS PER ANNUM IN SIZES FROM 4½" O.D. THROUGH 10¾" O.D., TO API SPECIFICATIONS 5A, 5L, AND 5LX.

IT GIVES US REAL PLEASURE TO INFORM OUR FRIENDS IN THE OIL INDUSTRY THAT MANNESMANN TUBULAR PRODUCTS, LONG KNOWN TO THEM FOR UTMOST QUALITY AND DEPENDABILITY, WILL BE AVAILABLE SOON, "MADE IN CANADA".

OUR SALES STAFF IS MAKING EFFORTS TO CONTACT ALL PIPE USERS; BUT WE SHOULD ALSO BE GRATEFUL FOR YOUR INQUIRIES WHICH MAY BE ADDRESSED TO OUR PRINCIPAL SALES OFFICE IN SAULT STE. MARIE, ONTARIO.

ESTABLISHMENT OF THIS NEW MILL REFLECTS OUR FIRM CONFIDENCE IN THE FUTURE OF THE OIL INDUSTRY, AND OUR EARNEST DESIRE TO RENDER THE FINEST SERVICE. WE SHOULD BE HAPPY TO ASSIST YOU WITH YOUR 1957 PIPE REQUIREMENTS; AND IF THERE IS ANY WAY IN WHICH WE CAN BE OF ADDITIONAL SERVICE, THE MEMBERS OF OUR ORGANIZATION, AND I, PERSONALLY, WILL WELCOME YOUR SUGGESTIONS.

SINCERELY YOURS,

GERHARD WAGNER, PRESIDENT

World Review

International Oil Review

The Fifth World Petroleum Congress will be held in New York City, May 30-June 6, 1959.

Europe

A major crude pipe line of 30 inches diameter and about 700,000 b/d capacity is being studied by Royal Dutch Shell. The line would run from marseilles on the Mediterranean to Cologne in Western Germany, where it could connect with the proposed Ruhr pipe line to Wilhelmshaven on the North Sea. Branch lines would run to Paris and Strausbourg. Middle East crude could be put in the line at Marseilles at a saving of about one-third of the tanker cost from Lebanon or Syria or about one-fifth saving from the Persian Gulf. Western Hemisphere crude could be entered from the Wilhelmshaven end if necessary.

The proposed line is especially appropriate in view of an OEEC study which indicates that energy demand in Europe will increase 15% over the 1955-1965 period and 65% during 1955 to 1975. In 1975 European energy demand is estimated at 1.1 to 1.3 billion tons of coal equivalent, of which oil would be 37%. This means imports will rise to cost about $5 billion yearly in 1975 at present prices. Imports of heavy crude from the Western Hemisphere will probably increase to supply Europe's growing heavy fuel oil demand, which is now at 62-63% of total consumption.

AUSTRIA Crude production levels during the first four months of 1956 were down 5.6% below the corresponding period in 1955. The lower production rates have necessitated 10-15% reduction in Austrian refinery runs.

The recent election resulted in 82 seats for the Conservatives (People's party) and 74 for the Socialists. The oil industry will probably not be completely freed or nationalized but ruled by a coalition body.

NETHERLANDS N. V. Nederlandse Aardolie Maatachappij, owned jointly by Shell and Jersey standard, has applied for a 530,000 acre exploration concession, which includes the towns of The Hague, Rotterdam, Leyden and Dordrecht.

Middle East

Ultimate reserves of the Middle East have been estimated by a British industry source at around 200 billion barrels. About half of this amount remains to be found, principally in the foreland zone where major fields are now located.

ABU DHABI a deep exploratory well will be drilled 20 miles offshore from the island of Das by British Petroleum and Cie. Francaise des Petroles. Work is being done by Abu Dhabi Marine Areas Ltd. A drilling barge is being towed to the Persian Gulf at a cost of about $14 million.

IRAN The government is considering granting oil concessions outside the Consortium area. These would have to be contracts through NIOC, which since 1951 has had a monopoly over oil in the entire country.

Oil exports during the first quarter of 1956 totaled 368,100 b/d, of which 239,580 b/d was crude and 128,520 b/d was products.

ISRAEL Israel Continental has given 50% interest in its 100,000 acre concession adjacent to the new Heletz field to Pan-Israel and Israel-Mediterranean companies. The companies will drill one deep test and 10 structure holes.

KUWAIT Crude exports during the first 4 months of 1956 were 139,346,953 barrels (1,161,224 b/d). Major destinations were: U.K., 43,296,780 barrels; France, 18,395,788 barrels; U.S.A., 17,254,768 barrels; Holland, 13,907,533 barrels; Italy, 11,303,551 barrels; and Aden with 10,324,345 barrels. Distillate exports for the same period were 308,826 barrels (2,573 b/d).

LEBANON The government has announced through Minister of State Saeb Salem that all IPC installations in the country are to be regarded government property as of May 25. IPC recently offered to settle a long-standing transit dues argument with the government on the same basis as with Syria, but the offer was refused. A simultaneous announcement stated that Tapline's offer of a 50-50 profits split had been accepted by Lebanon.

The cabinet decided to impose tax, customs duties and municipal dues on Iraq Petroleum Company following July 29. IPC has been exempt from these assessments to date.

NEUTRAL ZONE Exports during the first four months of 1956 were 17,964 b/d by American Independent, 13,514 b/d by Getty Oil.

QATAR Exports during 1955 were 5,262,365 long tons (about 105,247 b/d), up 15.8% from 1954.

SAUDI ARABIA Aramco has announced an exploratory discovery at Kharsaniya No. 1, about 80 miles northwest of Dhahran and the first test on the Kharsaniya structure. On drill stem test the well flowed 2,200 b/d from between 5,954 and 5,976 feet with a surface pressure of 800 psi and a gas-oil ratio of 340. Oil was sour and of 32° to 33° A.P.I.

SYRIA Yugoslavian geologists have been exploring throughout the country since April, according to reports. Russian turbodrills are being used for exploratory drilling, produced by the Mannesmann-Trauzl factory in Austria.

YEMEN Negotiations are in progress with Russia through Emir El Badr, Crown Prince, for exploration concessions. Yemen recently signed a barter agreement for petroleum products with Russia.

Africa

ALGERIA CREPS was recently awarded an exploration permit covering 2,800 square miles near Ensalah oasis, considerably south and west of the recent discoveries.

EGYPT Petroleum traffic south-north through Suez in the first four months of 1956 was 16% over the same period in 1955. In the north-south direction traffic increased 8%, due entirely to a tripling in Soviet and Romanian shipments. A study on the Suez Canal is being made by a private firm to enable the canal company to forecast traffic loads.

LIBYA W. R. Grace has received a 49% share in Texas Gulf's concession in exchange for financing of the majority of exploration costs. Grace recently purchased 50,000 shares of Texas Gulf stock.

SOMALIA Sinclair Somal has spudded Gira No. 1, an exploratory well 27 miles west of the coastal town of Obbia.

Asia and Australasia

BRITISH BORNEO British Malayan Co.'s Jerudong No. 2 well, the first post-war discovery in British Borneo, has gone on stream at about 628 b/d. Jerudong 3, 4 and 5 were dry holes. Jerudong 6 was completed as small producer in May. Jerudong 7 has been spudded in.

INDIA Two drilling rigs were purchased from Russia during May. Cost was $1.3 million and services of 44 Soviet technicians for six months were included.

SENEGAL British Petroleum has received a concession over 15,638 square miles. Exploration will be through a French company owned 50% by BP, 50% by the French government.

Latin America

BOLIVIA Siles Zuazo has been elected president and the National Revolutionary Party received a majority in Congress in the recent elections. The new oil law and Gulf contract will probably receive congressional approval this Fall.

BRAZIL Government statistics give consumption in 1955 at 180,019 b/d of which 175,704 b/d was imported. The government plans to exchange its paraffin-base Bahia crude of high gravity for imported crude. The exchange would increase Brazilian supply, since Bahia crude sells for about $4.50 per barrel, compared with around $2.46 for Middle East crude ex Tripoli and Sidon, plus transportation costs.

A public opinion poll by a local oil company showed a majority of the public favors admission of foreign capital to the oil industry.

Pumping on Brazil's 1955 discovery at Nova Olinda was not effective and has been discontinued.

COSTA RICA Union is testing Cocoles No. 1 and describes results as "not very encouraging." The company plans to drill an offset, however, and a well across the border in Panama.

CUBA Cuba-Juanita No. 1, a wildcat well about 20 miles east of Havana, came in with heavy (11° API) oil from about 2,177 to 2,250 feet. The well is owned by Ted Jones through United Cuban. Cuban American's Catalina No. 1 two miles south of Jatibonico gave 30 bbls./hour 32.9 gravity crude on a drill stem test with ¼-inch choke at 3,400 psi. The well was spudded May 29. It cored limey factured shale from 7,100 to 7,137 feet.

GUATEMALA Of the 29 applicants for exploration concessions, 23 have now been declared eligible by the government to receive concessions. They include subsidiaries of Signal, Tidewater, Ohio, Continental, Amerada, Shell (through Petroleum Investments Ltd.), Texas Petroleum Co., Union, Esso, Sun Production Co., Standard of California (through Cia. Petrolera California), Husky Oil (through Jaime Allan Willard Duran), Sante Fe Drilling (through Petroleos Guatemaltecas), Central American Oil and Mining Co., Inversiones Guatemaltecas, and Signal Exploration. Seaboard Exploration of Illinois was declared eligible for 15.3% of requested area, Bandini Petroleum for 67.7%, Story J. Sloan of Houston for 64.6%, Antonio Molina Murillo for 12,350 acres and Petroleos Atlas de Guatemala for 25.8%. Overlaps must now be worked out between eligible companies before July 3. Archer Oil, Cia. Petrolera Guatemalteca, Shawano Dev. Corp., Norman Stone of Houston, A. K. Swann of Indiana, Halbert & Jennings and Garfield and Pasternack of Denver were declared ineligible to receive concessions.

PANAMA Two new refineries have been authorized. A 55,000 b/d refinery, plus an $11 million petrochemical plant, will be built near Colon by Panama Refining and Petrochemical Co., headed by John M. Shaheen. A second plant of about 50,000 b/d is reportedly to be built by National Bulk Carriers in Colon Province. Both plants would be on the Atlantic side.

A 2,240,000 acre concession has been granted to Consolidated American Industries, a company holding various enterprises but entering oil exploration for the first time. Sinclair Panama Oil, partly owned by Cities Service Co., drilled two dry holes in the same area in 1949. The recent discovery by Union Oil in Costa Rica has aroused new interest in this basin, known as Bocas del Toro.

TRINIDAD Texaco has offered $176 million for assets of Trinidad Oil Ltd. The company produced 18,735 b/d during May and refined 76,479 b/d during 1955. Trinidad markets with Caltex in England. The sale aroused considerable opposition in England but Parliamentary approval has been received.

Two deviated wells will be drilled by Trinidad Northern Areas from its offshore platform in the Gulf of Paria. A 160 b/d discovery, named Soldado No. 1, was made in 1955. Depletion allowances were granted in early 1956.

VENEZUELA Final bids were accepted June 9th for offshore exploitation concessions on 271,810 acres in Lake Maracaibo. Minimum price was $483.20 per acre (4,000 Bolivares per hectare). The acreage was divided into 11 concessions of 24,710 acres each. This area adjoins producing areas held by Shell and Creole companies. Unofficial reports indicate that 8 of the 11 exploitation concessions offered, have been granted. Total sale price was reportedly over $190 million. Venezuela's largest producer, Creole Petroleum, reportedly received one tract, Mene Grande received 4, Cia. Shell, Sun Oil-Atlantic Refining, and Sohio-Signal-Hancock-Pure Oil combine received one each. The latter reportedly gave over $26 million for the one tract.

The government announced on July 4th that six new areas totaling 42,688 acres are now available for exploration bids. The areas are for exploration, not exploitation and are all National Reserves, located in Lake Maracaibo. Minimum requirements were as follows: (1) minimum initial payment was 5,000 Bolivares ($600) per acre; (2) Royalty was 16-2/3%; (3) concession holders will be required to refine at least 15% of production in Venezuela or establish a refinery in Venezuela. Companies shipping crude to Caribbean or Netherlands West Indies refineries must pay an 8% tax on the sale value of production so refined.

North America

CANADA Trans-Canada Pipe Lines Ltd. has received a government loan of up to $80 million for financing the first leg from Alberta to Winnipeg of the world's largest natural gas pipe line. The money was given after a heated debate in Parliament for which the government had to invoke the rule of closure to limit debate.

25TH ANNIVERSARY of MICROWAVE COMMUNICATIONS

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Canadian Notes

Sohio Establishes New Office In Calgary

Sohio Petroleum Co. has established a production department office in Calgary, Alberta to handle oil exploration in northwestern Canada. In Saskatchewan and Manitoba Sohio participates in a three-company joint venture which will continue to be handled by the Regina office. Robert Duff Roberts has been named to the post of manager of the Sohio Calgary office.

Campo Named President

A. F. Campo, executive vice president has been named president of Canadian Petrofina, Ltd., succeeding L. B. Wolters, vice president and managing director of the parent company, Compagnie Financiere des Petroles Petrofina, S.A.

Appointed Manager of Supply Div.

R. Anderson, formerly vice-president and general manager at the Regina, Sask. plant of Royalite Oil Co. has been appointed manager of the supply division at Calgary.

J. C. Browning, refinery superintendent at Coleville, Sask. has been made assistant manager of the Saskatoon refinery.

President of Electro-Technical

Ernest Hall, Jr., former vice-president, sales and engineering, has been named president of Electro-Technical Laboratories, Canada, Ltd., with headquarters in Calgary. Peter C. Sundt, who formerly headed the production-design department was promoted to assistant general manager of Electro-Tech.

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Wilburn T. Askew

Heads Sun Oil In Canada

Wilburn T. Askew has been elected president of Sun Oil Co. Ltd., of Canada, effective Sept. 1. Until recently he was manager of the parent Sun Oil Co.'s Marcus Hook (Pa.) refinery. Joseph N. Pew, Jr., was president of the Canadian subsidiary.

After Sept. 1 Mr. Askew will make his headquarters at the Company's offices at 85 Bloor Street, East, Toronto. Until then he will be engaged in visiting Sun Oil Co., Ltd., installations in Canada and meeting the latter's personnel.

John J. Schafer, managing director of the Canadian company, will continue under that title as a consultant to Mr. Askew.

Mr. Askew will be the first resident president of Sun Oil Co. Ltd. His election is regarded as the major initial step toward a far reaching independent integration of the company as a Canadian enterprise.

Increased Union Sales to Trans-Canada

Trans-Canada Pipe Lines Ltd. and Union Gas Co. of Canada Ltd. have amended their contract to provide for the sale of substantially more natural gas than could be committed when the original agreement was signed January 18, 1955.

Under the new agreement, the maximum annual volume which Trans-Canada is obligated to deliver to Union is 12½ billion cubic feet in the first year. It increases to a maximum of 64 billion cubic feet in the 13th year and continues at that quantity to the end of the contract. Under the original contract the maximum volume levelled off at 15½ billion cubic feet in the 6th year.

Imperial Studies Nova Scotia

Two Imperial oil geological parties, consisting of three men each, will spend the summer in Cape Breton Island exploring the oil possibilities of some 280,000 acres in the Lake Ainslie area, south of Inverness. The Nova Scotia government has granted Imperial a license to explore the tract. The area has had an intermittent, but unrewarding, interest for oil men since the earliest days of the Canadian oil industry. First tests were as early as 1864 at the site of oil seepages near Lake Ainslie.

Appointed Chief Geologist

W. W. Charles, Jr. has been appointed chief geologist of Canadian Oil Companies, Ltd. He was formerly with Central Leduc and Pacific Western Oil Corp.

New Pipe Line In Saskatchewan

A permit has been issued to South Saskatchewan Pipe Line Co. to construct a 59-mile extension of the main pipe line system from Dollard to Regina.

South Saskatchewan Pipe Line Co. began construction of the $2.9 million, 10,000 b/d, 12-inch crude oil pipe line during the third week of July to connect the Bone Creek, Gull Lake, North Premier and Dollard fields in southwestern Saskatchewan. Construction is expected to be completed by late summer and be in operation by Oct. 1, of this year.

E. J. Gallagher

Personnel Changes Follow Gulf Purchase

Following the recent acquisition of Canadian Gulf Oil Company by British American Oil Company Limited, a number of personnel changes have been announced to cope with the company's expanded activities.

L. G. May has been named production manager for the company's production department in Calgary. Mr. May joined the Fort Worth division of Gulf Oil Corp. at Odessa, Texas in June, 1938, as roustabout and was made assistant zone petroleum engineer in 1946. He was with Kuwait Oil Co. until 1952 when he was transferred to the post of assistant to the coordinator of production in Pittsburgh. In August, 1954, he joined Canadian Gulf Oil Co. in Calgary as assistant production manager and retained this position until his present appointment as production manager.

E. J. Gallagher was named assistant general manager of the company's production department in Calgary. He will assist O. I. Torkelsen, vice president and general manager, in the management of of the company's enlarged operations in Western Canada, including those formerly conducted by Canadian Gulf Oil Co. Mr. Gallagher joined the Tulsa division of Gulf Oil Corp. 26 years ago. In October of 1952 he was transferred to Calgary and appointed production manager of Canadian Gulf Oil Company's production operations in Canada.

J. H. Manning has been named zone exploration manager for Saskatchewan and Manitoba, with headquarters at Regina, Saskatchewan.

O. W. Wall has been appointed assistant production manager of the company's production department in Calgary. Mr. Wall's association with British American began in 1936. In his new capacity he will be assistant to L. G. May, production manager of the company's greatly enlarged production operations, including those formerly conducted by Canadian Gulf Oil Co.

H. S. Sparrow has been appointed general manager, crude and products supply department.

Gas Sales By Trans-Canada

A sales contract has been signed between Trans-Canada Pipe Lines Ltd. and Northern Ontario Natural Gas Company Ltd. The 20-year contract involves more than 100 million cubic feet daily. Northern Ontario Natural Gas will distribute the gas to 25 municipalities and many industries located from Kenora, in the west, to North Bay.

Volume of gas sold under the contract begins at 57 million cubic feet daily in the first year of Trans-Canada's operation through Northern Ontario and builds up to the 100 million cubic foot daily in the fifth year. Additionally, Northern Ontario Natural Gas has contracted for volumes of seasonally firm gas ranging from 25 million cubic feet daily in the first year of Trans-Canada's operation to 10.4 million cubic feet in the fifth year. This gas is sold on an off-peak seasonal basis to industries which have alternate fuels available when the pipe line capacity is required for "firm" customers in the winter months.

Growing Caracas need never go thirsty!

Down the mountains of Venezuela into Caracas, run 17 miles of 48" water line, tightly joined by nearly 4,000 steel couplings from Dresser Manufacturing Division, one of the Dresser Industries.

Throughout the world, over half-a-million miles of pipe have been joined with Dresser couplings. Fittings as small as three-eighths of an inch, or so huge that a large truck can be driven through them, are not uncommon in Dresser production. Whether lines are rigid or flexible, carry air, gas, petroleum, power, chemicals, steam or water, Dresser provides guardians of safety . . . leakproof, weather-proof, quickly and easily applied.

Operating independently in its specialized field, each Dresser company possesses the experience, facilities and engineering manpower to meet the progressive needs of the industries it serves. Whenever an unusually challenging problem is put before any Dresser operating unit, the research, engineering and production facilities of all the divisions of Dresser Industries, Inc. can be swiftly mobilized into efficient and effective teamwork.

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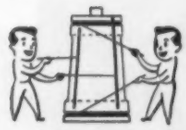
5 Reasons

why you can't buy better valves than

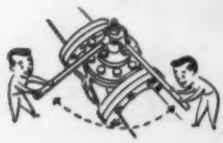
NORDSTROM and AUDCO

The longer life and lower end cost of Nordstrom and Audco valves have been proven through many years of service in the petroleum and gas industries.

Below are five outstanding features of Nordstrom and Audco valves. They are the reasons why you can't buy a better valve anywhere, at any price.



1. ***Pressurized lubricant provides positive shut-off.*** Lubricant sealing is *continuous* . . . it can't be scratched or eaten away like ordinary exposed valve seats. Positive shut-off eliminates costly or dangerous leakage and prevents product contamination on petroleum processing operations.

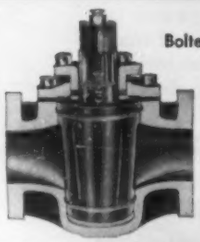


2. ***Quick, quarter-turn, rotary action.*** The tapered rotary plug principle is the simplest, most positive valve action known. The tapered plug maintains an intimate working contact with the seat at all times. Quarter-turn rotary operation is two to five times faster than ordinary valves.

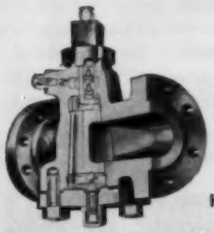
3. ***Lubrication and unexposed seat save repair costs.*** In Nordstrom and Audco valves the seats are *never* exposed to corrosive-erosive material. Any material touching the plug in the closed position is scraped off as the plug is turned back to open. Metal-to-metal wearing friction is eliminated by lubricant on the working surfaces, assuring longer valve life at lower cost.

4. ***Simplest of all valve designs.*** There are only three basic parts comprising standard Nordstrom and Audco valves —body, cover and plug (the only movable member). It is a mechanical axiom that "the fewer the parts the fewer the repairs." Allows operation by inexperienced help.

5. ***Adjust or lubricate under pressure.*** Nordstrom and Audco valves are the only types of valves that can be fully adjusted and lubricated in service. In any operating position, the plug can be jacked from its seat by a few turns of the lubricant screw or by injections with a lubricant gun.

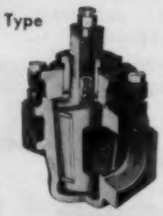


Bolted Gland Type

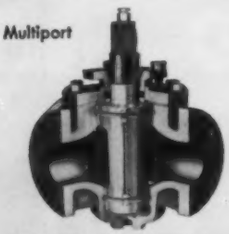


Hypreseal

Screwed Gland Type



Multiport



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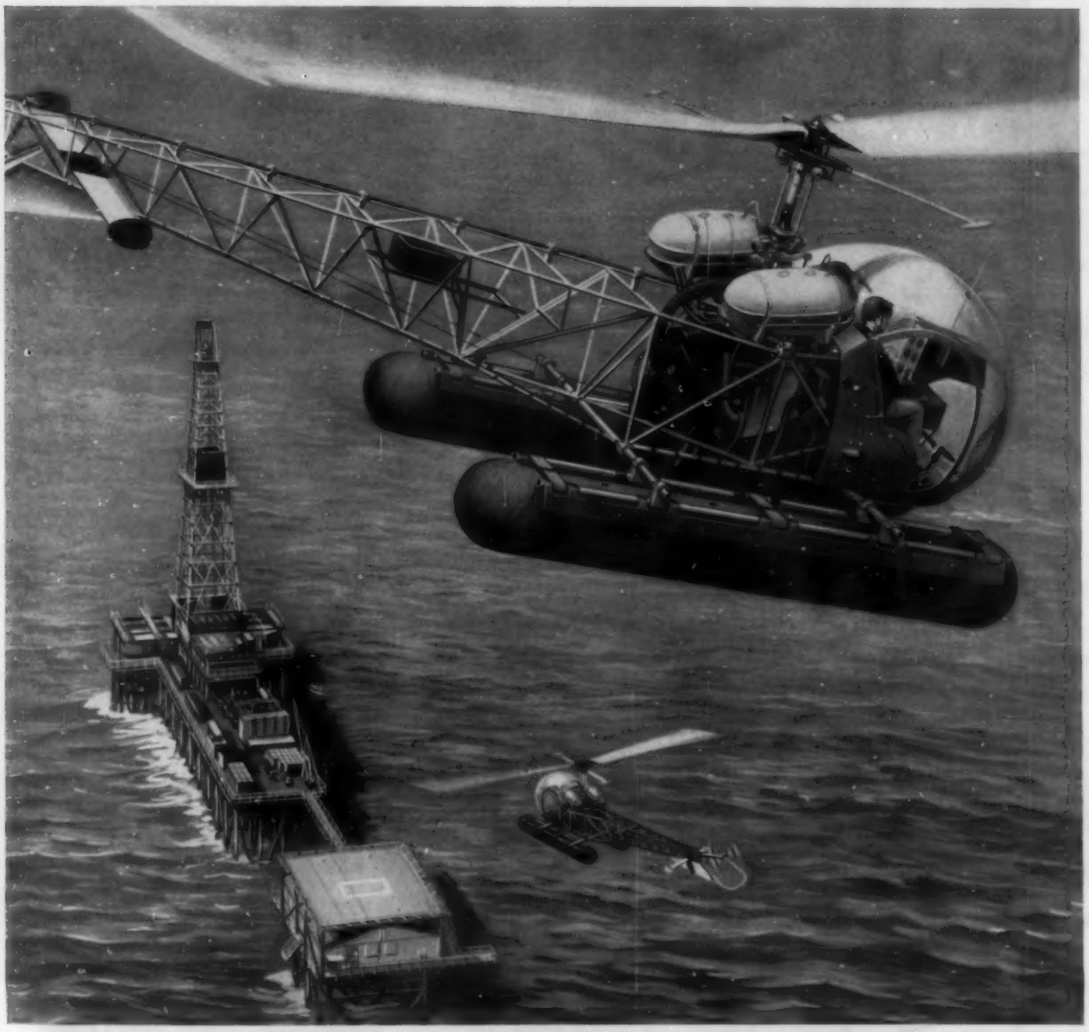
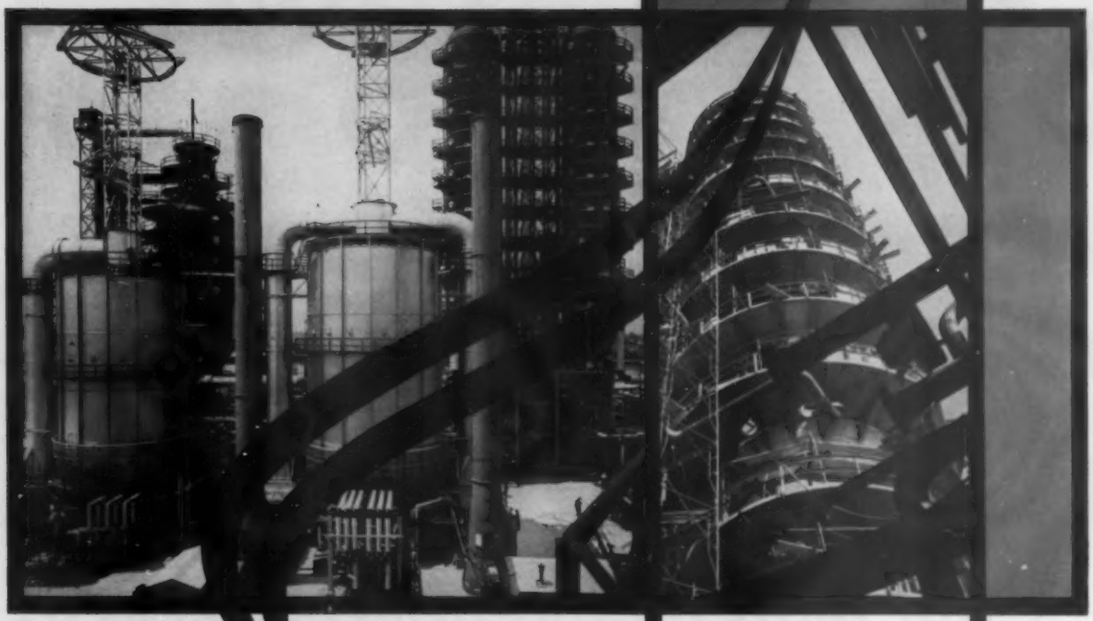


PARSONS



SINCLAIR REFINING COMPANY'S New Distillation Units By PARSONS

One of the largest installations of petroleum distillation capacity is now on stream at the Sinclair Refinery in Marcus Hook, Pennsylvania.

Daily capacity of the crude units is almost 150,000 barrels and that of the vacuum column is 38,000 barrels.

Design, procurement, and construction are by PARSONS.

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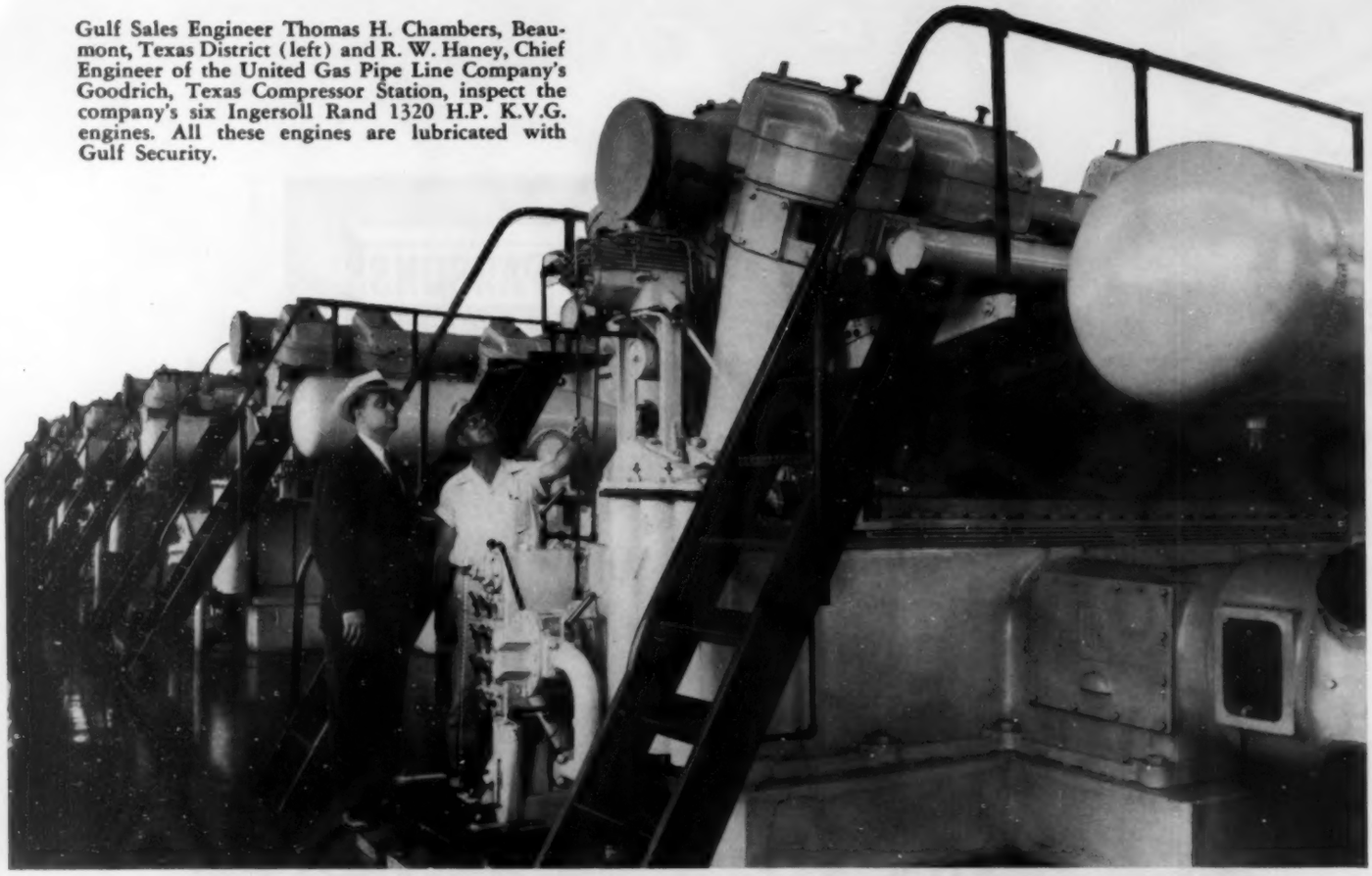

Gulf Sales Engineer Thomas H. Chambers, Beaumont, Texas District (left) and R. W. Haney, Chief Engineer of the United Gas Pipe Line Company's Goodrich, Texas Compressor Station, inspect the company's six Ingersoll Rand 1320 H.P. K.V.G. engines. All these engines are lubricated with Gulf Security.

Lock out high maintenance costs in your gas transmission plants

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Gulf Security's outstanding record in the lubrication of pipeline gas engine compressor units is your assurance of smooth, continuous operation. In scores of gas transmission plants this high quality straight mineral oil helps prevent operating troubles and contributes to low maintenance costs.

Gulf Security is a non-additive oil that does not cloud liquid filled lubricators of power cylinders, compressor cylinders, and packing glands. After years of operation with Gulf Security, cylinders and piston rings of both compressors and power assemblies show negligible wear, and its excellent oxidation stability helps prevent the formation of acid and resins in the crankcase system.

Make certain your units receive safe, effective lubrication protection—specify Gulf Security. And remember that Gulf provides the services of a trained, experienced petroleum expert—the Gulf Sales Engineer—to help you with any problem involving a petroleum product. Consult the telephone directory for the number of your nearest Gulf office.

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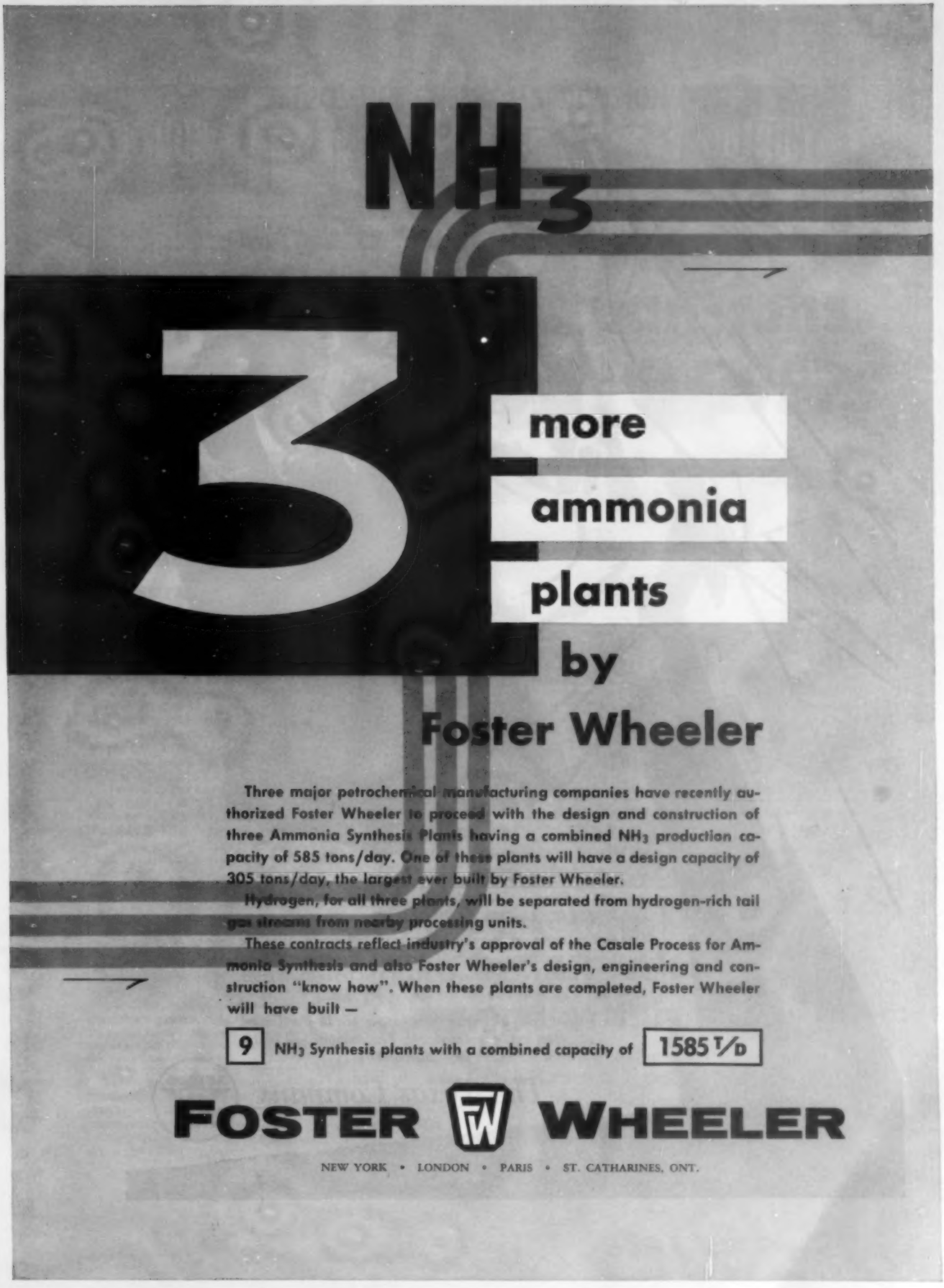

Three major petrochemical manufacturing companies have recently authorized Foster Wheeler to proceed with the design and construction of three Ammonia Synthesis Plants having a combined NH_3 production capacity of 585 tons/day. One of these plants will have a design capacity of 305 tons/day, the largest ever built by Foster Wheeler.

Hydrogen, for all three plants, will be separated from hydrogen-rich tail gas streams from nearby processing units.

These contracts reflect industry's approval of the Casale Process for Ammonia Synthesis and also Foster Wheeler's design, engineering and construction "know how". When these plants are completed, Foster Wheeler will have built —

9 NH_3 Synthesis plants with a combined capacity of **1585 T/D**

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COPPER is a metal with a future even brighter than its long and useful past. The giant steps being taken today in the electric and electronics industries have given it more to do than it ever had before. Result: more and more copper ore is being taken from the earth. As is the case in so many other industries, efficient operation depends to a great extent on efficiently lubricated equipment. We of The Texas Company are happy to have had a hand in this job for the copper industry. In fact . . .

For over 20 years, more copper ore in the United States has been mined with Texaco-lubricated equipment than with any other.

The Texas Company

TEXACO

PETROLEUM CHEMICALS DIVISION
NEWS

August ★ One of a Series of Bulletins for the Petroleum Industry ★ 1956

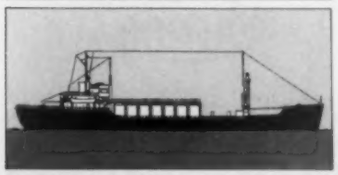
Major Du Pont expansions to serve TEL users in 1957

TEL TO BE TRANSPORTED BY TANKER FOR FIRST TIME

New Installation at Beaumont Insures Ample Supply at all Times

There will be *three* major distribution points for Du Pont TEL by the first of the year. A new tanker-supplied storage and delivery terminal is now being built in Beaumont, Texas. This new facility will offer the same delivery service and assurance of dependable supplies as the two Du Pont TEL manufacturing plants at Carney's Point, N. J. and Antioch, Calif.

The Beaumont terminal will be supplied from Du Pont's Chambers Works plant by a specially-designed tanker. Her initial TEL cargo will mark the first time tetraethyl lead compounds have been transported over water in bulk.



DESIGNER'S SKETCH of the special Du Pont TEL tanker. The cylinders you see in the midship section are for TEL. The ship will be painted a distinctive green and yellow.

In addition to this terminal, the Du Pont Petroleum Chemicals Division maintains a sales office, regional laboratory and warehouse in Houston . . . offering full additives service for refiners in the Gulf Coast area.

***THIS MAP SHOWS** that Du Pont facilities for serving TEL customers are located close to the major refining areas.*

ADDED SUPPLY FOR WEST COAST REFINERS

New California TEL plant to be in production by end of this year

Already more than 50% completed, the new Du Pont tetraethyl lead plant at Antioch, California, is expected to go on stream before the end of 1956. So if you operate a refinery on or near the West Coast, you can plan on a handy source of supply for your TEL requirements next year.

OVER

ADVERTISEMENT—Prepared for the Petroleum Chemicals Division of E. I. du Pont de Nemours & Company (Inc.)

PETROLEUM CHEMICALS DIVISION
NEWS

CONTINUED *New Plant*

The new plant is located approximately two miles east of Antioch on the San Joaquin River. This makes it readily accessible to both water and rail transportation. Added to existing Du Pont facilities, the new plant will for the first time provide West Coast refiners with TEL that is West Coast-*made*. The plant will enable us to give nearby customers the fastest possible delivery service, with ample stocks always on hand.

Modern design

The latest technical advances in tetraethyl lead manufacture have been incorporated into the design and equipment—making it the most modern TEL plant in the world.

Expanding need

Due to the rapid expansion of the West Coast refining industry, there is a definite need for the new California plant. It will supply refineries in California, Oregon, Washington, Arizona, Nevada, Idaho, Montana and British Columbia.

Architect's sketch of the new Du Pont TEL and "Freon" plants at Antioch, California.

Integrated facilities

Added to the present Du Pont Petroleum Chemicals Division regional laboratory at El Monte and sales offices in Los Angeles, San Francisco and Seattle, the new TEL production facilities at Antioch will mean completely coordinated facilities for manufacturing and servicing the area's needs for TEL.

Sharing the same site is a new plant for making Du Pont "Freon"* refrigerants and propellents. This plant is now practically completed.

The Antioch plant will become an important new consumer of local materials, and when completed, the new Du Pont TEL facilities alone will provide production jobs for 215 employees. Most of them will be hired locally.

**Registered trademark*

WEST COAST MEDICAL SUPERVISOR

LAWRENCE A. GERLACH, M. D., is stationed at Antioch, Calif., in charge of the various Du Pont medical services in connection with the manufacture and distribution of tetraethyl lead in the Western Region.

He joined the medical staff of the Du Pont Company in 1947 and was assigned to the Petroleum Chemicals Division. Recently, due to the increasing refining activity and demand for TEL along the West Coast, he was transferred from Wilmington and stationed in this area. Prior to World War II, he was engaged in private medical practice in New York City and also served as Flight Surgeon, U. S. Naval Reserve.

In 1940 he joined the U. S. Army Air Corps Reserve as a pilot. He was called to active duty as a test pilot, in which capacity he served throughout World War II. He was returned to inactive duty with the rank of Lt. Colonel in 1947.

Dr. Gerlach was awarded the Air Medal and Distinguished Flying Cross for his military service. He is a Fellow of the American Medical Association and also holds a Fellowship in the Industrial Medical Association.

He is co-author of the book, "Maintaining Hygiene in TEL Operations."

LAWRENCE A. GERLACH, M. D.

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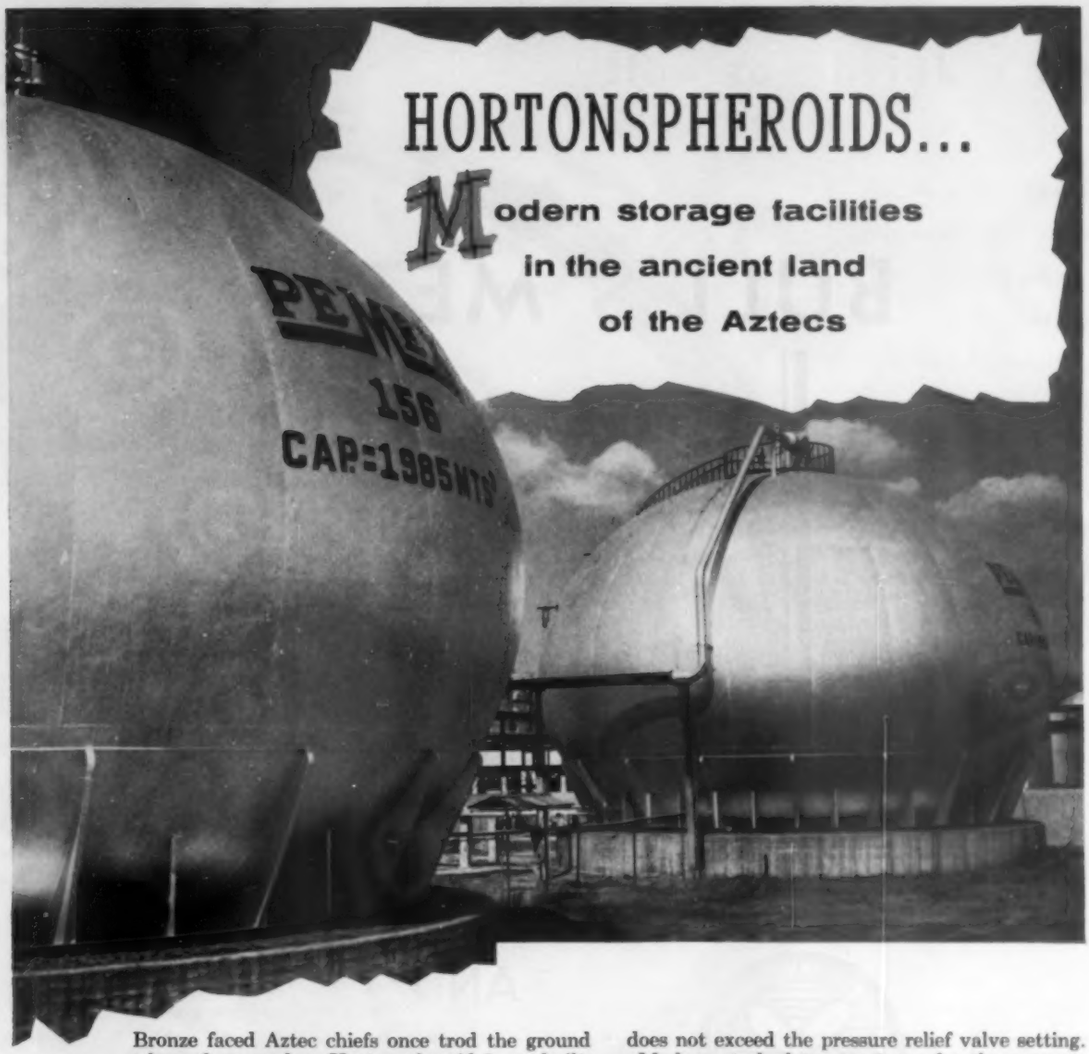

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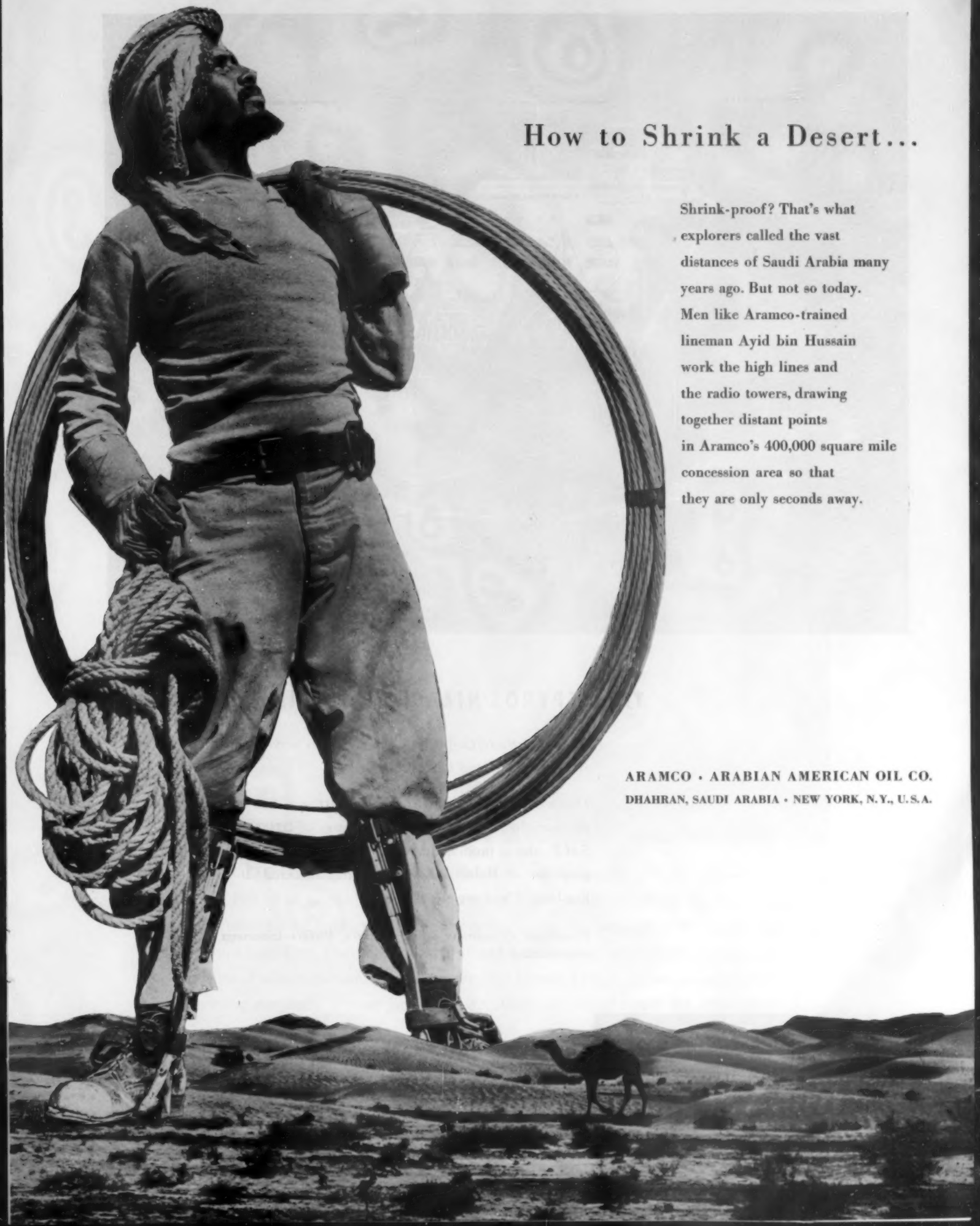

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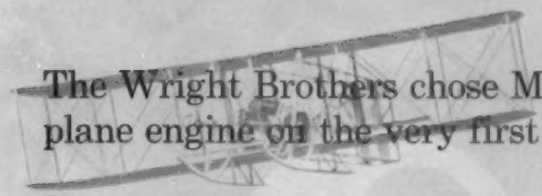

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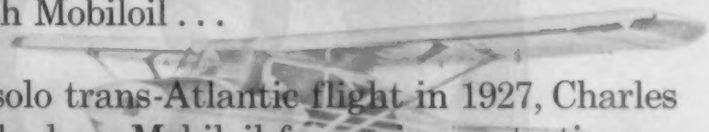

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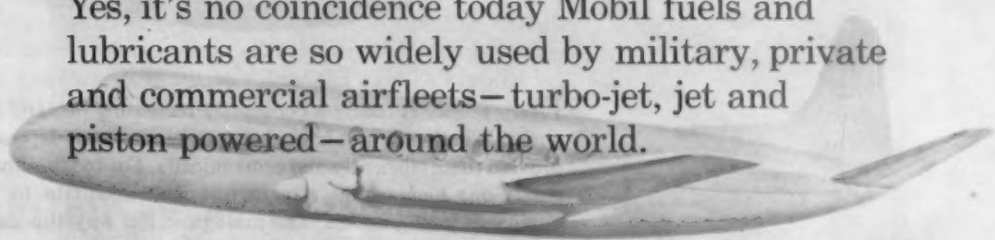

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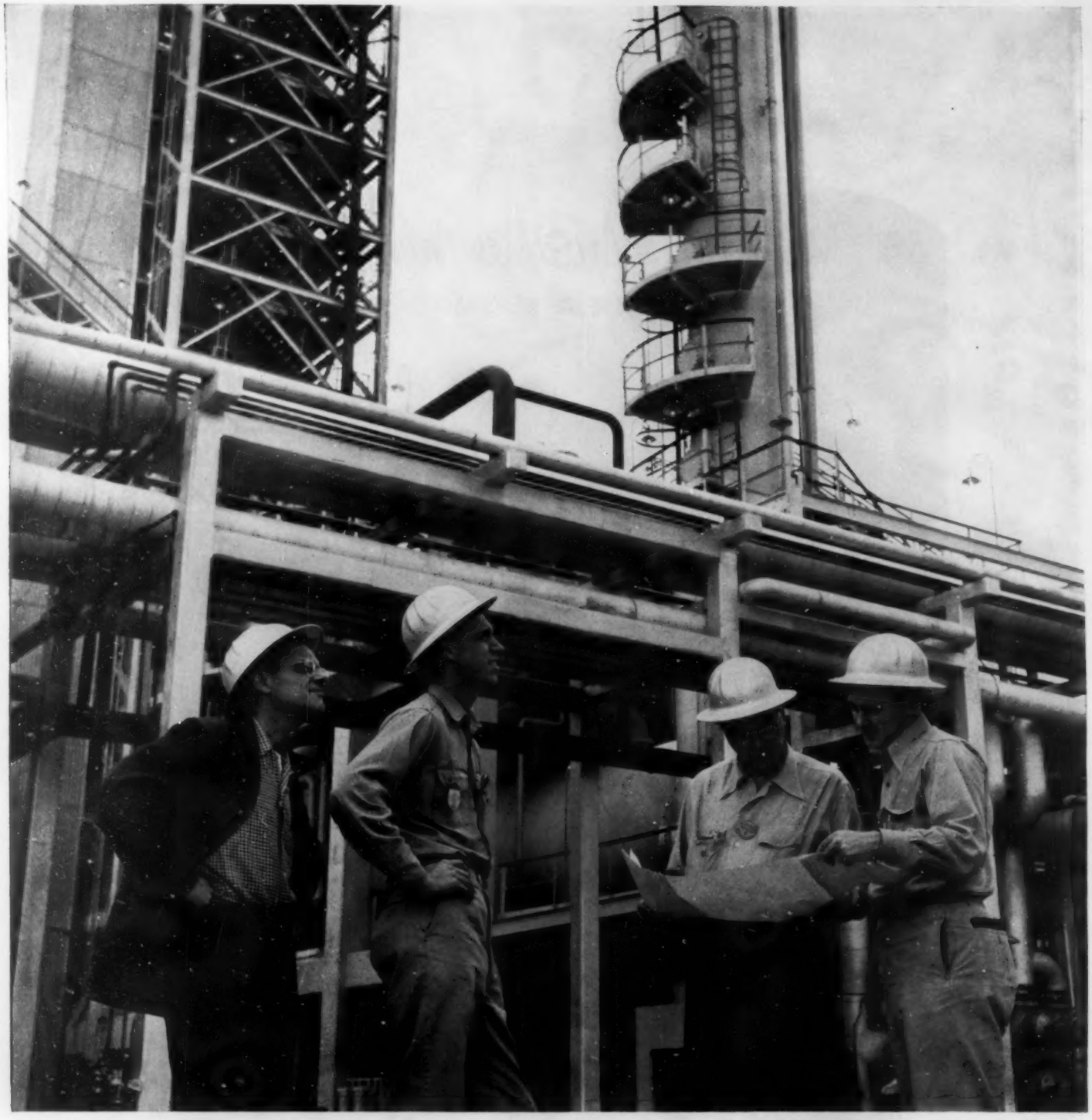

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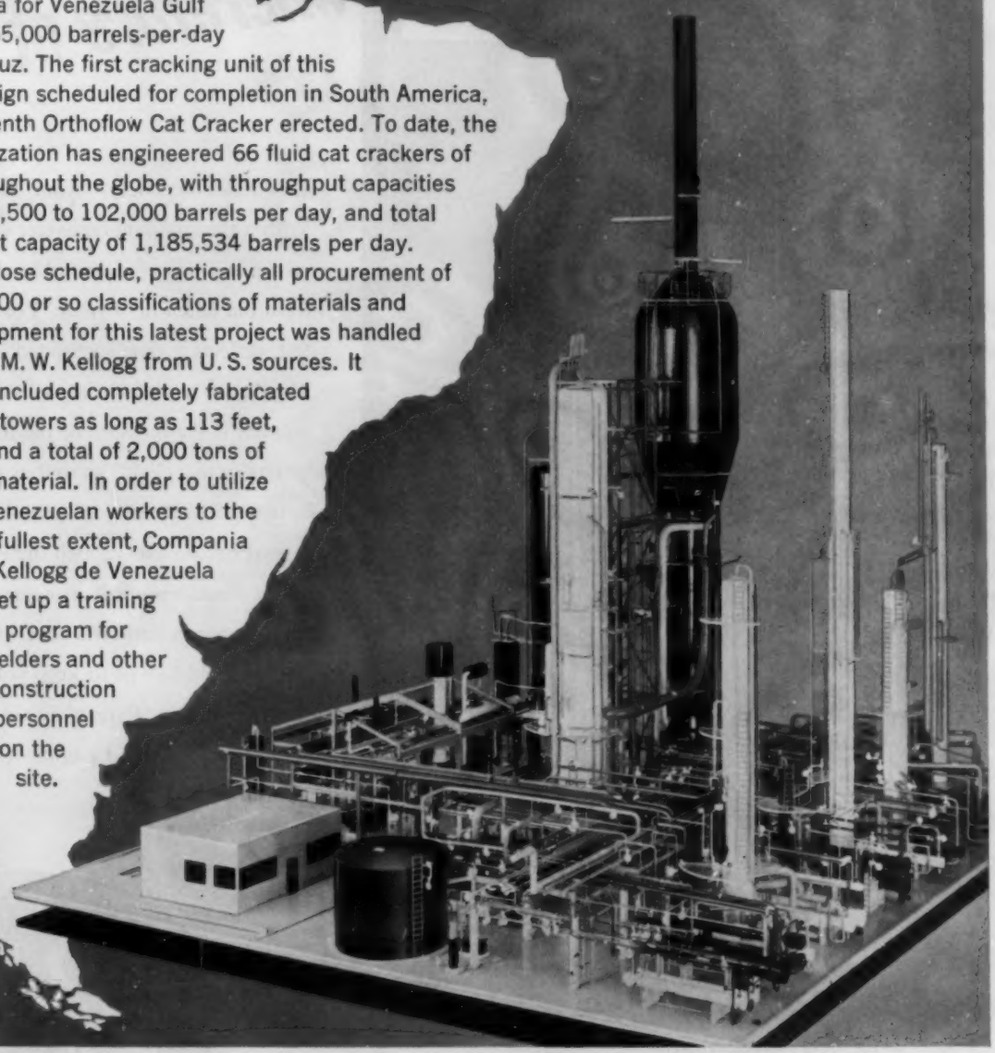

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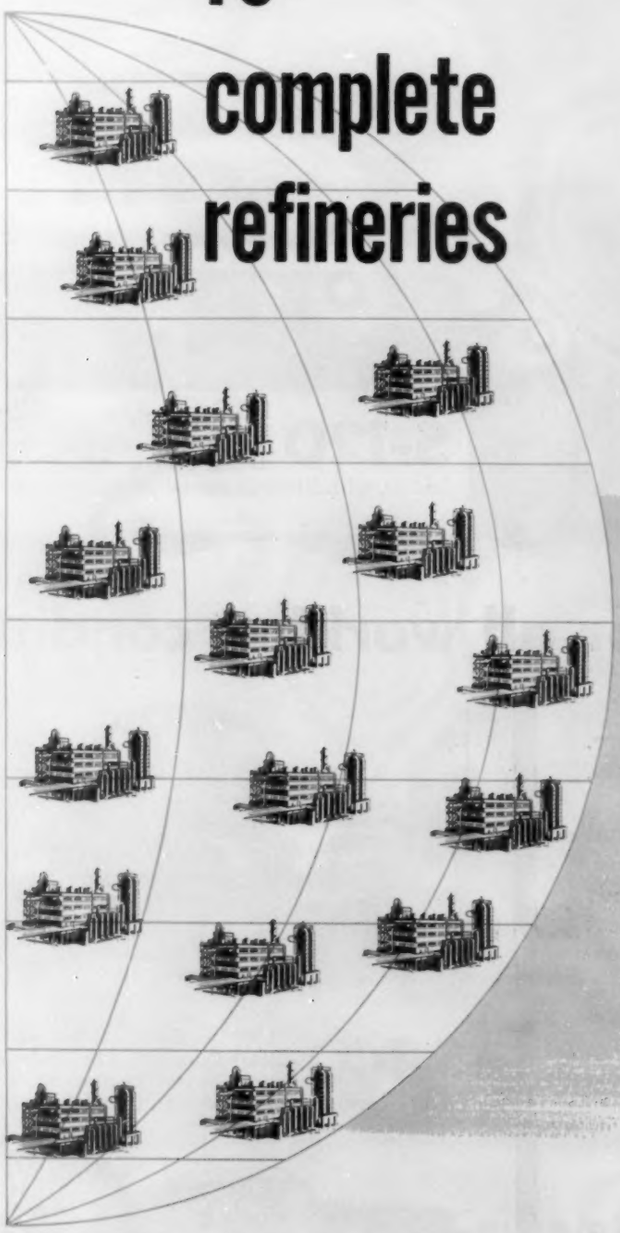

1945

1. Refinery for B. P. M. at Cardon, Venezuela.
2. Refinery for Koppartrans Oljeaktiebolag at Gothenburg, Sweden.
3. Refinery for Venezuela Gulf Refining Company at Puerto La Cruz, Venezuela.
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6. Lube oil refinery for Cit-Con Oil Corporation at Lake Charles, Louisiana.
7. Refinery for International Refineries Inc. at Wrenshall, Minnesota.
8. Refinery for Vacuum Oil Company Ltd. at Coryton, England.
9. Refinery for Burmah-Shell Oil Company at Bombay, India.
10. Refinery for Standard-Vacuum Oil Company at Bombay, India.
11. Refinery for Standard Oil Company (Indiana) at Mandan, North Dakota.
12. Refinery for Suntide Refining Company at Corpus Christi, Texas.
13. Refinery for Commonwealth Refining Company at Ponce, Puerto Rico.
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VOL. 27, NO. 9 AUGUST, 1956

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THIS MONTH'S COVER

The oil industry's global transportation system extends far into the hinterland of every continent. By water, land and by air the industry delivers fuels and lubricants. Pictured on this month's cover is a step in the delivery of products by The Texas Company in Africa. Drums are being unloaded from a Congo River steamer at equatorial Wendji after a 415-mile voyage up river from Leopoldville in the Belgian Congo. From this point the oil moves to consumers by vedette, canoe and head load. Photo is by Homer Page for The Texas Company and color plates are reproduced through the courtesy of Ellis Prudden, editor of *The Texaco Star*.

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Economic Concept Should Rule Oil Depletion

NUMEROUS studies by men who are entitled to be regarded as experts on the oil industry as well as professional statisticians are in virtual agreement that the growth in American consumer demand for petroleum products, calculated on a conservative basis, will continue for the immediate future at a rate as rapid as, if not greater than, that of the past decade. This means a doubling of current requirements in another 20 to 25 years. It also means, and therein lies a serious problem not only for the oil industry, but for the whole national economy. This resides in the fact that replacement of oil and gas consumed from year to year and therefore withdrawn for all time from future availability is not proceeding fast enough to satisfy growing requirements, let alone maintaining a safe margin of reserve.

Many times during the country's near-century of commercial existence there have been forecasts of the danger of running out of oil within a period of 10, 15 or 25 years, but always big new discoveries have intervened to avert the danger. Today's economists agree that the prospect of shortage exists unless steps are taken to increase production by making it attractive to risk capital and assuring a possibility of sufficient returns to the investor.

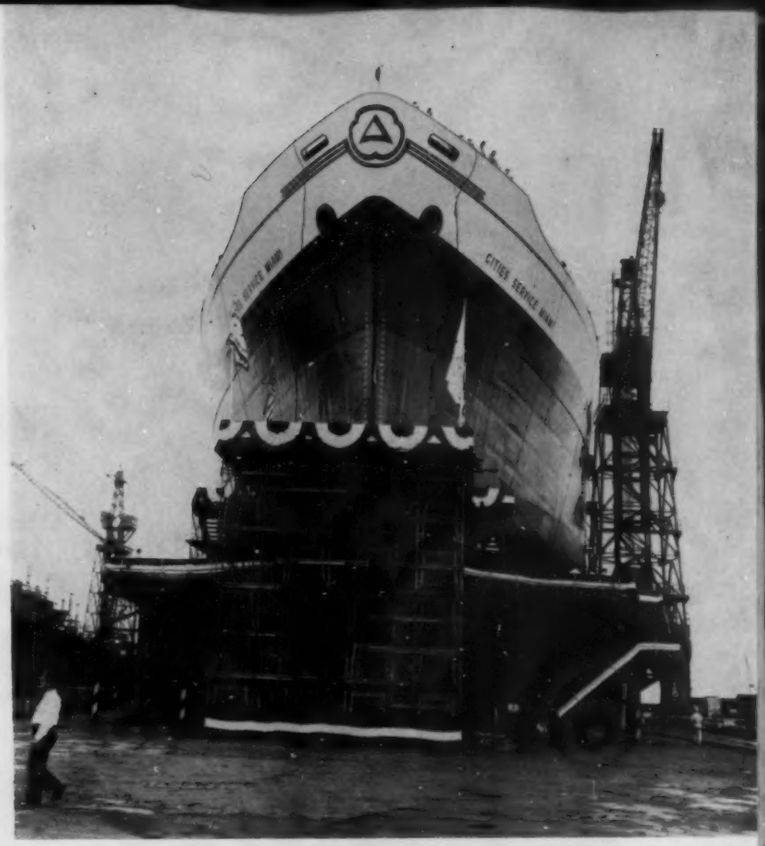
There is nothing mysterious about the causes responsible for the threatened failure of oil discoveries to keep pace with the growth in demand. It arises from the constantly rising cost and steadily increasing difficulty of finding new deposits to replace those that have been withdrawn from underground reservoirs. A simple and straightforward explanation of the threatening process under way and the means for its correction was the subject of an address before the Pennsylvania Grade Crude Oil Association at Bradford, Pa., on June 13 by James V. Brown, who has had an exceptional opportunity to study this problem as chairman of the Cost Study Committee of the Independent Petroleum Association of America and member of the industry committee advisory to the Office of Price Administration during World War II which strongly recommended a revision of the depletion and depreciation provisions applying to petroleum. Unfortunately the Office of Price Administration ended its existence before it could obtain adoption of its views.

Mr. Brown pointed out to the producers that the cash outlay of the petroleum industry in the United States for exploration, development and production in 1953 was $6.3 billion exclusive of income taxes, interest and payments on debts or to stockholders, or three times the cash outlay in 1944. The cost of materials has doubled during the past decade and wage costs have tripled. To find a new barrel of crude in 1955 required an average drilling of 62.8 feet or practically double the 31.6 feet in the five years 1937-41. The finding and development of a barrel of new production has multiplied fivefold since the prewar period while the price of oil has no more than doubled and 70 to 80 percent of its cost is absorbed by exploration and drilling expense.

Mr. Brown directed attention to the fact that much of the crude now being produced is being drawn from low cost fields brought in 15 or more years ago when finding costs were far less than they are today. As a result, the amount of new supply added to existing reserve is inadequate to maintain the needed reserve margin. The result is that the industry is in the position of selling off its stocks of goods on hand with the plain knowledge that these products cannot be replaced except at about five times the original cost.

"The reserves created each year through existing accounting charges for depletion and depreciation are woefully inadequate to do the job of providing the funds for replacing reserves currently consumed and equipment worn out," says Mr. Brown. "The only safeguard against ultimate shortage is to substitute the economic concept that the return of capital value through depletion and depreciation will permit replacement of assets used or worn out. In an expanding economy such as that existing today, assets cannot be replaced at their returned cost. This failure is applicable to all industry though more evident in an industry producing a wasting asset."

To be reasonably assured of remaining in business and maintaining the security of the nation, Mr. Brown points out that each barrel of crude entering consumption should be replaced by one and a half barrels added to reserve. While the number of well completions has been increasing from year to year, the nation has been losing ground in the ratio of reserves to consumption. At the end of 1955, the total known reserves of oil and gas, amounting to 35.5 billion barrels, was only 12.9 times the production of that year compared with an average of 15 times or better in the years immediately preceding World War II. Congress recognized 30 years ago the principle of replacement cost as the proper one to apply to depletion of oil and gas. The need now is to have the rate readjusted to modern conditions.



Cities Service "Miami," an American flag supertanker, launched May 23 from the Bethlehem-Sparrows Point Shipyard. Overall length is 661 feet, draft 33 feet, 11½ inches with 32,650 dwt. The cargo capacity is 273,175 barrels with special cargo piping to carry up to 18 different grades of oil and gasoline. (Photo courtesy of Cities Service Co.)

Larger and faster vessels now being launched are increasing oil carrying capacity faster than growth in tonnage.

World tanker fleet exceeds 41 million tons

By E. Lawson Lomax

WORLD tanker launchings decreased during 1955 for the first time in several years. According to Lloyds summary, there was a decrease in both gross tonnage and number of tankers launched. Launchings totaled 217 with a gross tonnage of 2,436,-642 compared with 267 vessels with a gross tonnage of 2,898,998 in 1954.

The decrease of 462,356 tons was accompanied by a marked change in the launchings from various countries. Losses were shown in vessels launched from British, Belgian, German, Swedish and United States shipyards and gains were registered in Danish, French, Japanese and Norwegian yards.

In 1955 in the U.S.A. only 13 tankers of a gross tonnage of 51,494 were launched compared with 23 vessels totaling 398,408 tons in 1954, this being the largest decrease in any of the tanker building countries. At the end of 1955 however there was an increase in the number of tankers under construction or on order over that at the end of 1954.

The next largest decrease was shown in Germany, the figures for 1955 and 1954 being respectively 31 ships of a gross tonnage of 243,405 and 41 ships of a gross tonnage of 443,840.

Decreases in launchings from British and Italian yards were between 60-70,000 tons. Italian yards launched the same number of smaller vessels, while British yards launched fewer ships. In Belgium and Sweden the decreases were between 40-50,000 tons gross. Because this amounted to more than half the country's launchings in 1954 in the case of Belgium, the repercussion was greater in that country. Losses in other countries were negligible.

The greatest gains in tonnage launched in 1955 over 1954 were shown in Japan where the tonnage launchings were about three times as great in 1955 as in 1954, although 25 ships were launched last year and 28 in 1954. Fifteen tankers of over 20,000 tons gross were launched from Japanese yards in 1955, as against five in 1954. Japan also shows the greatest increase of any country in the number and tonnage of tankers under construction or on order at the end of 1955. Most of these orders are for U.S. accounts, although some are placed by operators working under "Flags of Convenience."

The 47,500 dwt tanker "Spreyros Niarchos."

The only other countries with appreciable increase over 1954 are Norway, France and Denmark, but the total increase of these three countries only amounts to 53,675 gross tons.

At the end of 1955 there were 39 more tankers in service with an increased dwt of 2,016,300 as shown in Table I. During the year, 217 new tankers were launched, so it would appear that 178 tankers were scrapped or converted to other services.

The increase of 2,016,300 dwt was not comparable with the rise in world oil consumption, but new additions to the fleet are mainly in the higher speed range, while scrappings are mainly in the lower speed range, and so the rise in yearly transport capacity of the higher average speed range ships more than counterbalances the apparent tonnage shortage.

The registration of tankers under "Flags of Convenience," i.e. in countries where the shipping laws are less strict than in some other countries, is gradually growing, and the percentage of vessels registered under such flags is only exceeded by those registered under the U.S.A., British and Norwegian flags. A substantial portion of the American-owned commercial tanker fleet is operating under the flags of Panama and Liberia, and this includes many large and fast tankers, which in most cases are subject to the proviso that control shall remain in American hands.

This accounts for a certain extent to the decrease in vessels registered under the U.S. flag at the end of 1955, as compared with 1954 and also to the decrease in percentage of these vessels in the world's tanker fleet. The places in the world's tanker fleet held by Liberia and Panama have been exchanged. There are no significant changes with regard to other countries.

The number of steamers in commission dropped in 1955 because many of the tankers, now becoming obsolete and going to the scrapyard, are steam driven vessels of low tonnage.

In the "New Construction" the larger average size of both classes is noticeable as shown in Table II. During 1954, 17 tankers of over 20,000 tons gross were launched, but in 1955 this number had risen to 32. In 1954 there were only two over 25,000 tons, but in 1955 there were six of 25,000 tons and over. Still larger tankers are projected in the future, the largest to date being two 83,900 dwt turbine driven tankers ordered by Universe Tankships Inc. from the Kure Shipyard in Japan which are leased to National Bulk-Carriers Inc, New York. It is understood that these tankers are being built solely for oil carrying, although this same yard has orders from the same company for pulp-tank carriers and oil-ore carriers.

From information available, it is gathered that the design speed of these large tankers will be about 14 knots, and the shp of 19,500 required to develop this speed will be on one screw.

The size and draft of tankers of this carrying capacity must be very considerable. There are not many dry docks which could accommodate them for overhaul or in case of necessary repairs, while the weight of the propeller is a very important factor in case it should have to be removed for any reason.

TABLE II

SIZE AND PROPULSION OF THE WORLD TANKER FLEET

	1955			1954		
Type	No. of Vessels	Dwt	Average Dwt	No. of Vessels	Dwt	Average Dwt
Motor	1,400	18,875,868	13,483	1,356	17,956,067	13,242
Steam	1,332	22,154,944	16,633	1,337	21,058,442	15,750

New Construction 1955			
	No. of Vessels	Dwt	Average Dwt
Motor	199	4,081,295	20,509
Steam	364	11,228,590	30,848

The propeller of the "Spyros Niarchos," a 47,500 dwt tanker, the largest built to date in the U.K., weighed 30.6 tons. It was made of "Novostone," the special alloy of J. Stone & Co. (Charlton) Ltd. The propeller for the 83,000 dwt tankers, made in bronze, would weigh somewhere about 35 tons.

Until quite recently very few motor driven tankers of over 18,000 dwt have been put on order or built, all the larger sized tankers having been fitted with steam turbines. Recently, however, since the research department of Shell Tankers has shown that heavy grade boiler fuel could be successfully used in diesel engines, this form of propulsion has become more popular. Of the tankers on order or building in Continental yards at the end of 1955 there are practically equal numbers of motor driven and steam driven vessels. These ships use practically the same grade of fuel as that burned under the boilers of the turbine-driven vessels.

During the past few years there have also been specific improvements in air supercharging of diesel engines, whereby the same size of engine is able to deliver much more power. With little change in engine room size, etc., more shp can be produced, enabling the size of motor driven tankers to be increased. There are 41 motor tankers of over 20,000 dwt now on order or being built in British and Continental shipyards as follows: U.K., 2; Belgium, 1; Denmark, 3; France, 5; Germany, 5; Holland, 4; Norway, 8; and Sweden, 13.

Two of the motor tankers, to be built in France, by Chantiers de l'Atlantique (Penhoet-loire) to the order of Cie. Navale des Petroles, are the largest of their type in the world.

The average dwt of motor driven new construction was 18,688 in 1944, whereas in 1955 it had increased to 20,509. The average for steam driven vessels has also increased.

The following table shows the types of tankers on order or building at the end of 1954 and 1955:

	1954		1955	
	No.	DWT	No.	DWT
Diesel	199	3,719,070	199	4,081,295
Diesel El.	—	—	2	6,900
Turbine	222	5,889,070	364	11,228,590
Turbo-El.	1	18,000	—	—
Gas Turbine	1	18,000	—	—
Steam (Reciprocating)	4	81,830	4	80,300
	427	9,726,330	569	15,387,085

With regard to the gas turbine vessel shown in the 1954 list, it is understood that the order for this has been rescinded and that this type of propulsion is only being fitted at present on the "Auris." This is the

The 25,500 dwt tanker U.S.N.S. "Yukon." (Photo courtesy of The Ingalls Shipbuilding Corp.).

TABLE I

WORLD TANKER FLEET

(Vessels of 2,000 dwt and over)

	Dec. 31, 1955			Dec. 31, 1954		
	No.	Total dwt	%	No.	Total dwt	%
U.S.A.	520	8,130,035	19.81	546	8,469,289	21.71
British	537	7,479,279	18.23	537	7,280,785	18.66
Norwegian	399	6,295,372	15.34	376	5,746,390	14.73
Liberian	185	4,104,598	10.00	156	3,327,512	8.53
Panamanian	184	3,169,043	7.72	202	3,401,054	8.72
French	114	1,881,538	4.59	108	1,585,421	4.06
Italian	119	1,770,467	4.32	122	1,747,919	4.48
Dutch	115	1,376,447	3.36	100	997,035	2.56
Swedish	77	1,240,534	3.02	78	1,207,580	3.09
Japanese	57	944,716	2.30	61	969,384	2.48
Danish	47	789,293	1.92	42	669,975	1.72
Argentine	46	435,307	1.06	48	456,237	1.17
German	33	413,621	1.01	27	314,925	.81
Russian	43	361,316	.88	35	285,296	.73
Spanish	32	287,379	.70	29	248,559	.64
Canadian	46	283,782	.69	50	331,996	.85
Greek	18	254,622	.62	19	258,447	.66
Honduran	11	226,549	.55	12	239,134	.61
Brazilian	14	223,800	.55	15	225,988	.58
Venezuelan	32	209,048	.51	32	194,888	.49
Finnish	14	196,915	.48	13	171,581	.44
Mexican	20	194,076	.47	21	201,179	.52
Belgian	10	169,509	.41	8	120,062	.31
Portuguese	9	113,132	.28	8	96,954	.25
Turkish	8	80,311	.20	9	86,829	.22
Saudi-Arabian	1	46,550	.11	1	47,000	.12
Chinese	3	36,528	.10	3	36,400	.09
Uruguayan	2	33,230	.08	2	33,230	.08
Polish	3	29,773	.07	3	29,672	.08
Chilean	3	26,447	.06	3	26,447	.07
Egyptian	2	25,400	.06	2	25,400	.06
South African	1	24,600	.06	1	24,600	.06
Peruvian	5	23,786	.06	4	17,786	.05
Costa Rican	2	22,521	.05	2	22,521	.06
Israeli	2	21,823	.05	1	10,898	.03
Yugoslav	2	21,710	.05	2	21,710	.06
Australian	1	17,700	.04	—	—	—
Korean	4	16,788	.04	4	16,788	.04
Moroccan	2	15,137	.04	3	31,397	.08
Siamese	3	11,159	.03	1	2,000	.01
Pakistan	1	9,760	.03	1	9,760	.02
Colombian	2	7,380	.02	2	7,065	.02
Irish	1	3,350	.01	1	3,350	.01
New Zealand	1	3,325	.01	1	3,060	.01
Dominican	1	3,156	.01	1	3,156	.01
Swiss	—	—	—	1	7,850	.02
	2,732	41,030,812		2,693	39,014,509	

Table compiled for WORLD PETROLEUM by John I. Jacobs & Co. Ltd., London.

Captain W. M. Hutchinson (left) with Mr. K. W. Hopkins (right) of British Petroleum Co. Ltd. discussing details of the model of their hydraulic jetty fender. (Photo courtesy of The British Petroleum Co. Ltd.)

experimental tanker of the Shell Tanker Co., the first tanker to be fitted with a gas turbine which has now had her diesel units removed and is being fitted with a single gas turbine unit. The previous gas turbine unit delivered its power to the propeller through an electric motor, but in the new set-up with the single unit, the power is being transmitted to the propeller mechanically, a totally new system for this having been evolved by the experimental department of Shell tankers.

The largest tanker launched from British shipyards during the year was the S. T. "Spyros Niarchos" of 47,500 dwt which was launched from the Barrow Shipyard of Vickers-Armstrongs (Shipbuilders) Ltd., on Dec. 2, 1955. This tanker has since been completed and is now in commission.

The largest oil carrying vessel launched during the year was, however, the "Sinclair Petrolore," which as its name suggests is a combined oil or ore carrier. She was built in the Kure Shipyard in Japan and on her first voyage from the Middle East carried the largest cargo of oil ever transported by a ship, i.e. about 51,300 tons. The destination was Santos, Brazil, and before she could enter the oil port there about 3,000 tons had to be lightened. This lightening of the cargoes of super tankers is quite a business when these vessels are loaded in the Persian Gulf and are routed through the Suez Canal. Owing to the canal dues, it is cheaper to take a single large tanker with a short cargo through the canal, than two vessels carrying the same quantity. In some cases therefore these large tankers load up at a Persian Gulf port, down to the marks at which they can pass through the canal, and then make a diversion to one of the Mediterranean oil ports to top-up the cargo to the full extent. B.P. is favorably placed in this respect, as its tankers can be loaded down to their marks in the Gulf, discharge part of their cargo at the Aden refinery, and then carry out the same procedure on other tankers through the canal, and then on to their final discharge port.

The proportions of vessels ordered by the oil companies and by the independent carriers varies very little from year to year and during the past year there has been little significant change in the proportions. A new shipping entry in the U.K. is the Peninsular and Oriental Co. which has placed orders for 25 tankers, the first lot being due for delivery in 1958 with completion of the whole fleet by the end of 1960. The majority of these tankers will be general utility vessels of about 18,000 dwt each, but some of the vessels will be over 32,000 dwt each. The estimated cost at present prices is about £37 million.

Wm. Cory & Son, the well-known oil and coal contractors, and who have not previously been connected with tanker shipping, have ordered two 18,000 dwt tankers for delivery in 1958 and 1959. The company stated that if this venture proves successful, they will probably increase this number.

The Niarchos group of shipping companies at the beginning of 1956 had 22 new vessels under construction in various world's shipyards, aggregating about 724,700 dwt and at an estimated cost of over £35 million ($98 million). About 50% of this tonnage is being constructed in Japan, and the remainder in the U.K., U.S., Sweden and Germany. The reason for the large percentage going to Japan was that competitive and fixed prices were quoted, together with quickest deliveries.

In addition to the orders placed by independent carriers, large orders have been placed for tankers to be added to the fleets of various oil companies. The Shell Petroleum Co. announced in September 1955 that it was placing orders for 34 new vessels, consisting of an equal number of 18,000 dwt general utility tankers and of 32,000 dwt supertankers. Twenty of the

The 32,000 dwt S.T.S. "Vola" undergoing trials for Shell Tankers Ltd. (Photo courtesy of Hawthorn Leslie [Shipbuilders] Ltd.)

vessels will be built in nine yards in the U.K. and 14 in five yards in Holland. These orders follow the orders placed in 1951 for 70 tankers of various sizes.

British Tanker Co. Ltd. (now BP Tanker Co. Ltd.) announced in October 1955 that it had placed orders for 23 new tankers and later in May 1956 announced the ordering of nine more. The 23 announced in October 1955 are all of the super tanker category. Six of them are of 42,000 dwt and are larger than BP has previously ordered. Seventeen of the ships totalling 629,000 dwt are being built in British yards and six totalling 207,000 dwt in Italian yards. The estimated cost of the 23 tankers is about £52 million ($145.6 million). Delivery is to be made during 1958 and 1959. This is the first time that BP Tanker Co. Ltd. has placed orders for tankers outside the U.K. Early delivery was a compelling reason. In addition a greater measure of control over price variations in labor and material costs during construction of the ships has been found possible in negotiating with shipyards abroad than with the British shipbuilding firms.

The nine tankers placed on order with British shipyards in May 1956 at a cost of about £12 million ($33.6 million) are of a special type designed to meet certain port restrictions, and with any grade of petroleum cargo to load for such ports 14,000 dwt throughout the year on 27-foot 6-inch draft. Maximum assigned draft will be greater than this and will apply on voyages unlimited by port restrictions.

With the addition of these 32 ships and the disposal of old ships, the BP Tanker Co. Ltd. fleet will be 187 ships of 3,267,000 dwt.

Esso Petroleum Co. Ltd. also announced in September 1955 that it had placed orders for six new 36,000 dwt tankers. Two are to be built by Vickers-Armstrongs in England, four in German yards.

In October, the Eagle Oil & Shipping Co. Ltd., announced that it had placed orders in British yards for four tankers of 32,000 dwt and three of 18,000 dwt, all steam turbine propelled.

Also in October, Shell Tankers Ltd. ordered three 32,000 dwt and six 18,000 dwt tankers, all except one 32,000 dwt ship to be built in German shipyards.

The Confederation of Shipbuilding and Engineering Unions called for an inquiry into the reason for placing ship orders abroad. Stated reasons are the ever rising prices of building in British yards, which does not allow firm prices to be quoted by the builders.

According to Reuters, June 1, 1956, the American interests of Aristotle Socrates Onassis are negotiating with the U.S. Maritime Administration for the construction of a 100,000 dwt tanker to sail under the American flag. Preliminary designs for this tanker, which would be the largest in the world, have been made by Bethlehem Steel Co., and the vessel would be built in Bethlehem's Quincy Yard, Mass. The negotiations concern the nine T-2's owned by Onassis proposed to be transferred to foreign flags.

A new marine invention of interest to tanker operators is an hydraulic jetty fender and a quick release mechanism for ships' mooring wires, which were invented by Captain W. M. Hutchinson and K. W. Hopkins of BP Tanker Co. Ltd. The fender, which is designed to replace the usual wooden baulk backed with rubber, incorporates a cushioning arrangement of one or more liquid-filled cylinders fixed horizontally to a frame under the jetty below water level. The cylinders have a number of ports, or holes, to allow entry or escape of sea water, and are fitted with pistons.

The impact of a ship on the fender causes the pistons to eject water from the cylinders, while continued pressure causes some of the ports to be covered and so increases the resistance offered by the fender. The cylinders may be positioned on the jetty itself, in which case they can be oil filled.

The fender proper consists of one or more barrel shaped members rotatably mounted with their axis vertical in the frame. The barrel-shaped members rotate when struck by a vessel, thus accommodating a glancing blow.

The quick release mechanism for mooring wires is designed particularly for use

(*Continued on page 86*)

TABLE III

World Tanker Building

Vessels Building or on Order Dec. 31, 1955

	No. of Tankers Building	D.W.T.	Diesel	Diesel Electric	Turbine	Turbo-Electric	Reciprocating Steam	Oil Co.'s No.'s	Oil Co.'s D.W.T.	Independents No.'s	Independents D.W.T.
Great Britain	130	3,206,100	27	—	102	—	1	70	1,902,300	60	1,303,800
Belgium	7	157,100	2	—	5	—	—	1	30,150	6	126,950
Denmark	8	179,100	7	—	1	—	—	1	18,000	7	161,100
France	35	1,123,275	10	—	25	—	—	15	571,350	20	551,925
Germany	39	1,042,850	8	—	31	—	—	17	486,500	22	556,350
Holland	61	1,527,260	13	—	45	—	3	24	581,530	37	945,730
Italy	39	1,221,670	4	—	35	—	—	16	568,620	23	653,050
Norway	39	792,900	35	—	4	—	—	3	53,750	36	739,150
Spain	12	207,140	12	—	—	—	—	2	16,000	10	191,140
Sweden	69	1,589,000	61	—	8	—	—	1	39,000	68	1,550,000
Europe	309	7,840,295	152	—	154	—	3	80	2,364,900	229	5,475,395
United States	22	608,290	—	2	20	—	—	8	263,590	14	344,700
Japan	108	3,732,400	20	—	88	—	—	4	161,100	104	3,571,300
	569	15,387,085	199	2	364	—	4	162	4,691,890	407	10,695,195

The growing use of American Flag tankers in clean service on a continuous basis has increased the corrosion factor to an alarming degree. Oil shipping research is studying various coatings, inhibitors and cathodic protection to retard metal loss.

CLEAN SERVICE CORROSION

A SYMPOSIUM dealing with methods of controlling corrosion in clean oil tankers was conducted at the midyear meeting of the central committee on transportation by water of the American Petroleum Institute's transportation division. Papers detailing the experience of three companies were presented along with a report on corrosion costs compiled from the records of 15 tanker operators.

F. M. Watkins, tanker corrosion research coordinator for the API, stated that $150,000 per year is a conservative estimate of the corrosion cost for an average American Flag T-2 tanker in clean oil service. The estimate was based on data covering 101 vessels and involved structural repairs; loss of time; pipe, valve and pump repairs; gas freeing and rust removal; and the initial cost and revenue loss caused by installation of oversized scantlings.

Earlier tanker records indicated that vessels had a useful life of about 20 years. It now appears that this life expectancy depended on the fact that the vessels spent only six to eight years in clean service and 12 to 14 years in the less corrosive dirty service. Today clean service is occupying a greater proportion of the average tanker's time and they are not lasting 20 years.

An accompanying diagram (Fig. 1) from Mr. Watkin's report shows the growth in accumulated yearly average corrosion costs of a T-2 tanker. At the end of 15 years the average cost has reached $150,000 per year. In presenting the chart he directed particular attention to the fact that low costs during the early life of a vessel can lead to a false sense of security, but that the liability for future costs connects to "out-of-pocket expense" in the year that a horizontal line "yearly cost of corrosion" intersects the curve.

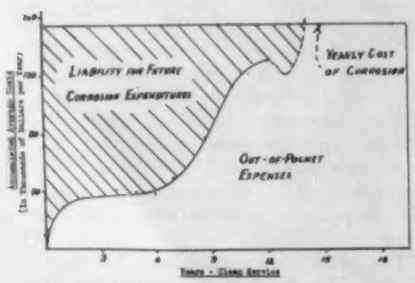


Fig. 1. Total accumulated average yearly corrosion cost (converted to equivalent T-2 tonnage).

W. B. Jupp, of Socony Mobil Oil Co., Inc. presented a paper giving the effects of corrosion rates on new design and maintenance. Studies were made of seven Socony ships to gauge the difference in corrosion rates between clean and dirty service. It has been accepted that corrosion in clean service is three times as great as in dirty service. The Socony studies confirmed this on the average, but found that corrosion of tank bottoms is twice as great in clean service, but four times as rapid in the upper part of cargo tanks.

On the basis of this study, it has been possible to create new designs allowing sufficient metal for a 16-year life expectancy. In a 27,000-ton ship, it was found necessary to add 115 long tons of steel over the ABS minimum to assure 16 years of service. Distribution of the added metal is as follows:

27,000-Ton Ship
Calculated Weight of Additional Steel Required Over ABS Minimum for 16 Years Life

	Additional Weight (Pounds)
Transverse bulkheads	42,670
Longitudinal bulkheads	43,899
Deck plates	———
Shell plate	———
Centerline deck girder	
Centerline vertical web	6,720
Transverse frame	63,128
All deck longitudinals	69,300
Upper shell longitudinals	32,130
	257,847

Mr. Jupp observed in his paper that these allowances provide for general corrosion but added measures must be taken at points of accelerated corrosion. These points represent two to three percent of the structure. During the construction of the vessel these points should be sprayed with hot metal to a thickness of 12 to 20 mils at a cost of about $1.60 per square foot. These sprayed points require yearly maintenance by wire-brushing and recoating. Bottom pitting also can be minimized by proper coating and less frequent Butterworthing. Unless special attention is given to coatings at points of rapid corrosion, vessel life may be reduced from 16 to eight or ten years.

G. B. Colberg, of Standard Oil Co. of California presented a paper describing tanker coating tests which have been carried out by his company since 1915. Early paints held up well until steaming and washing became necessary after which coatings usually failed.

In 1946 Socal began experiments with vinyl coatings which gave much better results. Two years ago an inorganic vehicle zinc coating was tried with good success. Based on an estimated cost of 28 cents per square foot per year for metal replacement, Mr. Colberg reported that tank coating costs only half as much as corrosion losses.

A tank in the "F. S. Bryant" was painted with a 6-coat vinyl system over a sand blasted surface during construction in 1946 at a cost of 62 cents per square foot. This coating has not been patched for 10 years, but there has been no appreciable loss of metal and rust removal has been minor.

Three years ago four 200-sq. ft. panels in one tank of the "Hillyer Brown" were coated with different materials:

"1. A catalytic-setting Epon in alternate orange-red and cream-white coats which gave dry film thicknesses ranging from six to ten mils.

"2. A vinyl type in multiple coats, meeting Navy Formula 113-49, in thickness ranging from three to six mils.

"3. A lead pigmented Epon in multiple coats with a dry film thickness of over ten mils, and

"4. An inorganic vehicle, single-coat zinc material, with film thickness varying from two to three mils."

Mr. Colberg told the API that a materials laboratory report of the March, 1956 inspection rated the two to three mil inorganic vehicle zinc as first; the six to ten mil Epon as second; the ten mil lead-filled Epon as third, and the three to six mil vinyl as fourth. The uncoated areas of the tank showed the usual rusting.

One advantage of the zinc coating he reported "is that it requires only one coat plus acid curing agent, which cuts labor costs. It is anodic to steel, protecting pin holes or damaged areas from undercutting. It can be applied as a finish of up to four mils dry film thickness in a double pass application without runs or sags and can be properly cured in this film thickness by a single application of curing solution. It

is insoluble in petroleum products, including petrochemicals, but is attacked by acids or alkalies. There is little spray drift when applying the zinc coating. This material can be used in confined quarters without worry over toxicity or flammability. Eye and skin protection is required because the vehicle is alkaline."

Mr. Colberg said that Socal's principal reasons for coating the interior of cargo tanks in clean service are:

"1. To eliminate cargo contamination and discoloration.

"2. To control corrosion.

"For a T-2 tanker, corrosion costs about $100,000 per year. The total internal cargo rank area is about 360,000 sq ft. Based on this area, the cost of corrosion is 28 cents per sq ft per year. The cost of coating a heavily rusted tanker, including sandblasting and application, is 90 cents to $1.00 per sq ft. It is estimated that recoating will cost about 40 cents per sq ft. It has been predicted that the coating will have a minimum life of five years. Therefore, based on $1.00 per sq ft for the original application, the initial coating will cost 20 cents per sq ft per year and recoating will cost eight cents per sq ft per year. For ten years' application then, the average cost per sq ft per year will be 14 cents. For longer periods, the average cost per year will decrease slightly. If tanks are coated at the time of construction, it is estimated that the cost will be eight cents per sq ft per year .Coatings maintained in this manner would give almost 100% corrosion control.

"Cathodic protection in ballast tanks costs approximately six and one-half cents per sq ft per year. Inhibitors will give protection in non-ballast tanks for about four cents per sq ft per year while effective fresh water Butterworthing in most trades can be done for about one cent per sq ft per year. The latter methods will reduce corrosion about 50% on the average. It is obvious that these methods are adequate to assure a 20-year life for a relatively new tanker in clean oil service without rebuilding. But after a tanker has been in clean service for a longer period, say six to eight years, almost 100% corrosion control is required if the vessel is to remain in that trade for 20 years.

"From the corrosion standpoint alone, we believe the most economical system for new tankers would be a combination of cathodic protection for the ballast tanks and fresh water Butterworthing for other tanks. Older tankers should be coated before the corrosion allowance has been used up; costly steel renewals are thus eliminated. For our services an organic vehicle zinc coating appears to be the best coating tested to date. It is not affected by hot or cold water and has no known limitations in any of the white cargoes carried.

"So far as coatings are concerned, they offer the following advantages:

"1. They give almost 100% corrosion control whether tanks are loaded, empty or in ballast;

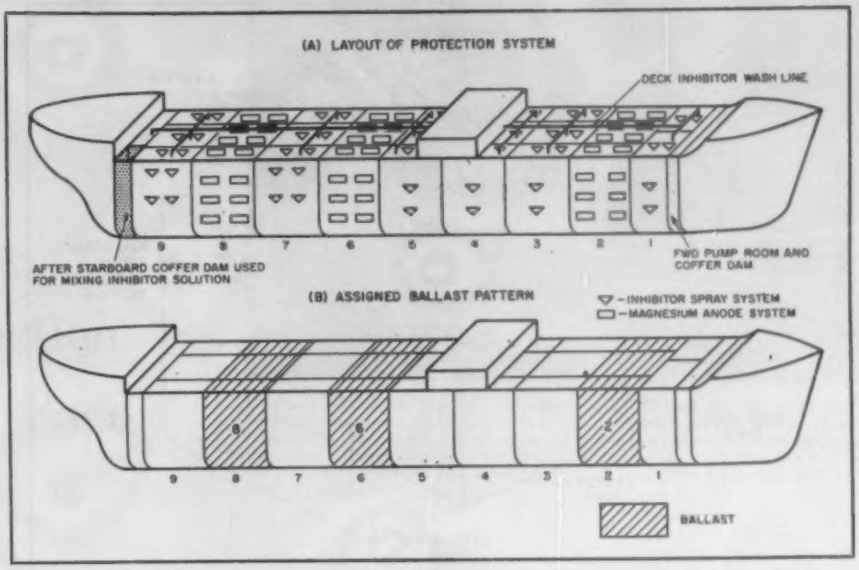

(A) LAYOUT OF PROTECTION SYSTEM
DECK INHIBITOR WASH LINE
AFTER STARBOARD COFFER DAM USED FOR MIXING INHIBITOR SOLUTION
FWD PUMP ROOM AND COFFER DAM
(B) ASSIGNED BALLAST PATTERN
▽ - INHIBITOR SPRAY SYSTEM
▭ - MAGNESIUM ANODE SYSTEM
BALLAST

Fig. 2. Typical arrangement of combination magnesium anode/inhibitor-spray protection installation in a T-2 type vessel.

"2. Coated tanks are easy to clean, scale removal is eliminated and gas freeing time is reduced by one-half;

"3. Coated tanks are safer; they remain gas free and vapors do not regenerate as easily as in heavily scaled tanks;

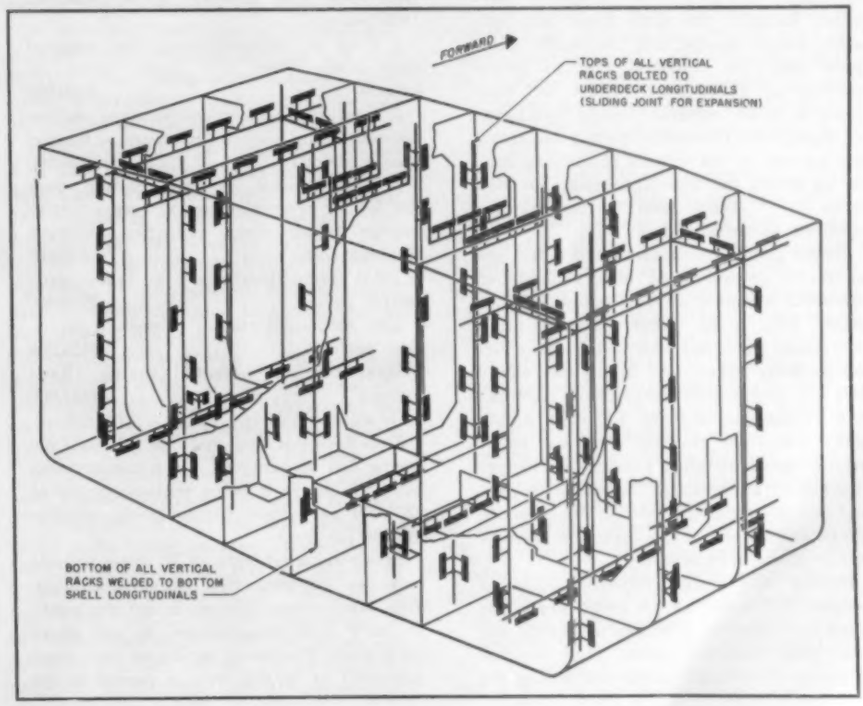
"4. There are coatings available that do not restrict products carried or ballast arrangements, and

"5. A coated tank insures delivery of clean, rust-free cargoes without discoloration."

A jointly prepared report by Esso Research and Engineering Co. and Esso Shipping Co. dealt primarily with the use of inhibitors and cathodic protection with magnesium anodes. Authors of the very comprehensive 42-page report are W. H. Radut and J. F. Koehler. They have concluded after extended research that the combination magnesium anode/inhibitor spray and full-scale magnesium anode with rotation of ballast offer substantial protection against corrosion. Final success of the program will not be finally proven for some years to come, but encouraging results have been obtained thus far.

Esso's study of corrosion has been on an

Fig. 3. Typical arrangement of magnesium anodes and support structure in center and wing tanks of T-2 type vessel.


FORWARD
TOPS OF ALL VERTICAL RACKS BOLTED TO UNDERDECK LONGITUDINALS (SLIDING JOINT FOR EXPANSION)
BOTTOM OF ALL VERTICAL RACKS WELDED TO BOTTOM SHELL LONGITUDINALS

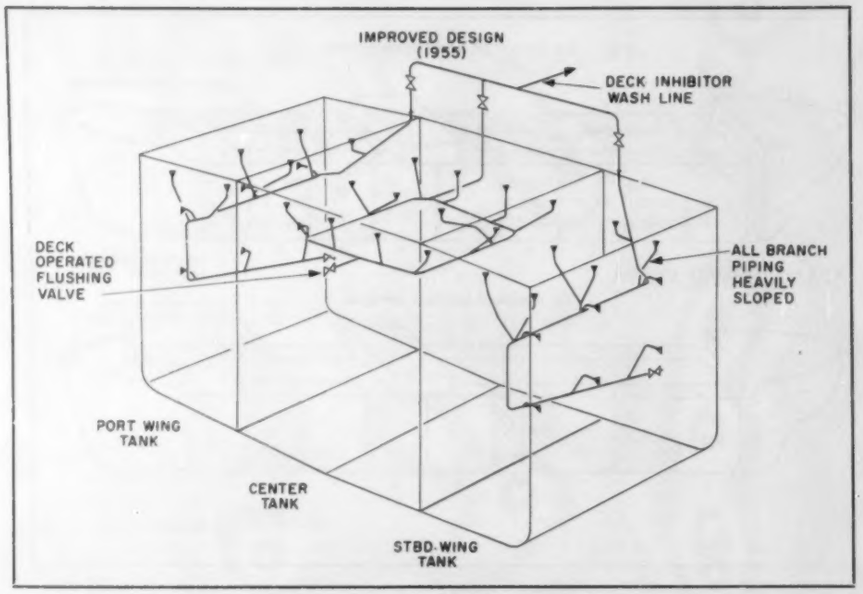


Fig. 4. Spray systems for inhibitor application.

intensive basis since 1950. The research has shown that corrosion within the cargo compartments of tankers is a continuous process. It is the result of exposure of the steel to oxygen and water forming ferrous hydroxide which then oxidizes to iron oxides. Also, sea salts as electro-lyte permit loss of ferrous ions through galvanic corrosion. The various factors contributing to the overall corrosion process during the routine operation of a tanker may be broken down into three phases: (1) ballast, (2) empty, and (3) cargo.

Exposure of the steel to sea water occurs during the ballast voyage when the tanker is empty of cargo, but has approximately one-third the cargo compartments ballasted. Usually, the same tanks are ballasted every voyage, but frequently other tanks may be ballasted due to heavy weather or shifting of ballast for tank cleaning, scale removal, testing bulkheads for leaks, etc. Corrosion during ballasting is enhanced by the activity of galvanic cells set up across the non-uniform-scaled surfaces. It is complicated further by the presence of entrapped oil.

When empty, condensate from the sea air forms on the inner tank walls when the metal temperature falls below the dew point. This may occur several times throughout each day due to the tanks being partially submerged in the sea where they are exposed to temperature differentials of sea and ambient air. Also, empty tanks are often cleaned with sea water fro high pressure spray nozzles for changes in grade or gas freeing. The alternate wetting and drying of the steel in the presence of salt and oxygen make corrosion wastage in this phase most severe.

During the cargo voyage, dissolved oxygen and water in the cargo keeps the many corrosion cells within the tanks active. This dissolved water plus residual ballast or condensate is trapped within the tanks, scale forming an interface of water between cargo and steel. As oxygen in the water is consumed in the formation of iron oxide, it is supplanted by dissolved oxygen in the oil cargo. The supply of oxygen in oil is plentiful; gasoline, for example, is capable of absorbing eight times the volume of oxygen that water absorbs. Cargo then is a reservoir for oxygen which feeds corrosion throughout the loaded voyage. Corrosion by oil products in the absence of moisture and oxygen is considered insignificant.

Esso has estimated the potential savings expected by inhibitor treatment and cathodic protection as follows for a T-2 type vessel over a 5-year period based on 1955 prices:

1. Cost of reconditioning the internal tank body after 5/7 years clean oil service $450,000
2. Cost of replacement tonnage during reconditioning period (in excess of normal repair period) $210,000
3. Miscellaneous savings realized over the 5-year protection period (reduction in voyage repair costs, reduction in tank cleaning costs, etc.) $40,000

Total potential savings over 5-year protection period $700,000

Less estimated cost of protection for 5-year period $153,000

Maximum net potential saving (Estimated) $547,000

Or approximately ..... $109.000/yr.

Esso does not feel that the full $547,000 saving can be achieved. On a conservative basis the figure is being tentatively put at $200,000 per vessel before taxes, roughly $40,000 per year.

Esso conducted tests on 57 water soluble corrosion inhibitors in a salt spray cabinet. Test panels were imersed in hot sea water at 150°F and then exposed to salt spray for a week. Promising inhibitors then were subjected to testing over a period of six months with alternating immersion in gasoline, sea water and moist salt air. It was found that inhibitors reduced corrosion by 50% or better.

Of the 57 inhibitors tested two have been most effective. One is a commercial inhibitor composed of two parts sodium nitrite and one part caustic soda. The other is sodium chromate with IGEPAL, a wetting agent.

The commercial inhibitor was used for two years in the SS Esso New Haven which was converted to clean service after nine years carrying crude. For this purpose selected test tanks were sprayed with a 6.9% inhibitor solution for one hour each ballast voyage. Sand blasted test panels after two years of treatment showed almost no corrosion.

The chromate inhibitor was tested in the SS Esso Scranton by spraying 300 barrels of a solution containing 2.9% sodium chromate and 0.05% IPEGAL. Over an extended period, corrosion was reduced 33%. Except at top locations, corrosion was kept below 0.007 inch per year over three years. A ten-year life expectancy is indicated by the test.

Oil soluble inhibitors proved much less satisfactory.

Inhibitors are effective in empty tanks, but of little or no value in ballast tanks. For this service Esso has been testing magnesium anodes for some years. In an early test on the SS Esso Scranton the anodes almost completely descaled the tanks in which they were installed within six months. Test panel data indicated a drop of 59% in rate of corrosion.

Based on the attractive test results, Esso has protected 11 of its U.S. Flag clean service vessels with anodes and spray facilities. The system involves the use of sacrificial magnesium anodes for protection of regular ballast tanks and an inhibitor spray, applied through a fixed spray system for protection of non-ballast tanks. Typical arrangements of the system are shown in Figs. 2, 3, and 4.

In order that all tanks may be protected, Esso follows a rotated system of ballasting. Every cargo tank is ballasted at least one out of every two or three voyages. Ballast level should be held well into batch tanks to assure full cathodic protection of the underdeck structure. Salt water should be used for ballast where possible. Since the interaction of magnesium and steel when immersed in salt water results in the evolution of hydrogen, precautions must be taken at sea and in the shipyard.

Esso has found that the initial installation costs $56,500 and operating costs for 10 years total $229,500 for the magnesium anode inhibitor spray system. With the rotated ballast system initial cost is $82,000, but 10-year operating cost drops to $173,-000. Yearly averages are $28.600 and $25,500 for the two systems.

Esso has concluded that the combination cathodic/inhibitor system is the best now available for controlling corrosion in clean oil vessels. END

Worldwide Pipe Line Construction Proceeds at Rapid Pace

Shown is construction on one U.S. segment of the 26-inch gas line being built by Pacific Northwest Pipeline Co. from San Juan basin in New Mexico to the Canada-U.S. Border. The hill in the background has a one to one slope, and four tractors were required to hold the backhoe digger on the slope. Another part of the job was a sheer 165 foot drop down a cliff face. (Photo courtesy of Caterpillar Tractor Co.)

Pipe line builders around the world are engaged in one of the busiest years they have known. Construction projects range from the world's largest pipe line in Canada to small but difficult and vital lines like Oleoducto del Pacifico in Colombia. In Europe a major crude line is under consideration that would effect substantial transport savings on crude imports.

Some of the problems encountered in pipe line building are illustrated by the new Oleoducto del Pacifico line which went into operation in Colombia earlier this year.

The line was built by an American firm, Williams Brothers, from Tulsa, with engineering by Pipe Line Engineering of Dallas. In a country marked by extreme oil transportation difficulties, the new system was a tremendous forward step in the industrial progress of Columbia's rich Cauca Valley. Taking nearly a year to build and winding up a centuries-old mountain mule trail from the Pacific port of Buenaventura to its inland terminal of Yumbo, it represents one of the pipe line industry's toughest construction jobs and an outstanding achievement by Colombian private enterprise, which owns 50% of the line.

Total cost was $5.4 million. The pipe line replaces a fleet of 95 to 100 tank trucks which had daily risked the dangerous mountain highway to supply the fast-growing city of Cali, a metropolis of 350,000, and surrounding farms and industry with an erratic 7,000 b/d. The new line furnishes a full flow capacity of 18,000 b/d and can be increased to 45,000 barrels with the use of additional equipment.

The pipe line is expected to save approximately $800,000 yearly in transportation costs and immediately upon opening the line gasoline prices were dropped one cent. The greater and cheaper supply of fuel has given new opportunities to Cauca Valley's industrialists and the valley a chance to continue in its growth.

Installation of the line began with the construction of a marine line from the island port across the bay to the mainland, a distance of 2,079 feet. Here the line moved across land saturated by abnormal coastal rainfall which often made it advisable to use heavy equipment in teams and stand-by equipment was to assist machinery that bogged down.

Criss-crossing the Dagua river at its mouth with a series of over-water crossings, the first portion of the line was completed with 11 submarine and seven suspension-bridge crossings as crews took advantage of low water periods of the usually fast flowing Dagua river.

A mule trail route was the only choice between the railroad on one bank and the river at the bottom of the V-shaped canyon. The railroad right-of-way was ruled out since the line would seriously weaken the railway foundation. Since the seven-mile mule trail, which had to be re-opened by hand labor, was less than six feet wide in most areas, Tulsa engineers were faced with the problem of scaling down as well as "beefing-up" the special field units.

Hand-operated pipe bending machines were built in Oklahoma and shipped to the field. Later, gasoline operated power units provided faster operation of the small hydraulic pipe-benders on the trail.

Since mobile equipment other than light machinery was prohibitive, Williams crews used sure-footed mules to deliver the 8-inch pipe to the trail.

Cleaning and wrapping of the pipe with polyethylene tape and asbestos felt was accomplished with mobile equipment on the trail. All of the light machinery was pulled the distance of the mule trail by hand.

Williams Brothers crews left the canyon near Puerto Dagua, to complete the first 65 kilometers of the line and picked up speed in the rolling country. Climbing eastward to its destination, the line rose to its highest point at Crestagallo, northeast of the Pavas valley, a plateau depression in the Colombian Andes 5,400 feet above sea level. As the line left the Pavas valley, it dropped in altitude as it approached Yumbo, 3,200 feet above sea level. Ditching was kept to a minimum because the greater portion of the line could be laid on top of the ground since most of the pipeline route crossed land unfit for agricultural use.

Elsewhere in Colombia the country received its first recent big production boost when Texas Petroleum Company's Velasquez field came on production with the completion of a new pipe line. The 12-inch line runs from Texas' properties at Teran-Guaguaqui to Galan, near Barrancabermeja, where it enters the common-carrier Andian system to Manonal.

In Venezuela Mene Grande is contemplating a 62-mile crude pipe line in 1957 of 30 inches diameter from Anaco to Puerto La Cruz. This would increase capacity already existing by 120,000 b/d to 580,000 b/d. Construction of a 100,000 b/d. 20-inch crude line from the Silvestre field in Barinas to Puerto Cabellon on the Caribbean will begin soon. Socony Mobil and Sinclair Oil are the constructors. Socony will be operator.

Cie. Shell de Venezuela has begun construction on a 177-mile, 20-inch natural gas pipe line connecting La Paz field in the Maracaibo district with the company's Cardon refinery on the coast. The line will cost around $21 million and will supply fuel to the refinery's furnaces thus conserving fuel oil for export.

In Brazil a new 6-inch pipe line was recently completed, running from the Bahia field where it has lifted production levels to around 7,000 b/d to the Mararipe refinery. The line is heated to carry the high paraffin content crudes produced in this area which have a very low pour point.

In Argentina large pipe line construction is planned as the government seeks to double production in the extreme northern fields of Campa Duran and Madrejones. Plans call for a pipe line from these areas to Buenos Aires, about 1,000 miles, and bids for the construction at an estimated cost of $95 million, have been submitted by sev-

eral firms according to reports. Payments are to be guaranteed by the Argentine Central Bank.

In Bolivia the 8,000 b/d 6⅝-inch line from Cochabamba to Oruro and La Paz was completed this year and began operation in February. The government has extended its pipe line system by nearly 435 miles in the last two years. Williams Brothers Co. completed a 210-mile line of six inches diameter from Camiri to Yacuiba on the Argentine border in 1955 and is currently planning an 8- and 10-inch crude line to Arica in Chile with the unusual feature of electric power generation through a turbine in the line on its descent to the coast. The government has been transporting product exports to Brazil by a railway bridge over the Rio Grande. The mixed Brazilian-Bolivian commission recently recommended a pipe line to replace these deliveries.

Private companies have recently entered the pipe line picture in Bolivia. Gulf Oil with Williams Brothers, Falcon Seaboard and Barry & Reiner Inc., recently entered into an exploration agreement with Y.P.F.B., the government oil agency, where exploration rights were received in exchange for pipe line financing. The planned line would go from Sicasica, Bolivia, some 201 miles west to Arica, Chile. Some 156 miles would be 10¾ inches diameter, and 45 miles would be 8⅝ inches. A pumping station would be located at Sicasica. Plans were drawn up by Williams Brothers, which also constructed all the other pipe lines that the government owns.

The plans also call for a marine terminal at Arica with facilities for receiving and distributing crude oil and products, and the erection of four 50,000-barrel tanks with floating roofs and a loading line to the tankers.

Under the letter of agreement, the government would pay $5.5 million of the cost; Bolivian Gulf would pay $5 million.

The Sicasica-Arica line is but one part of the oil expansion envisioned in Bolivia. The line will have a capacity of 50,000 b/d ultimately, because the government is optimistic about oil prospects.

In order to feed this much crude into the line, a second line, to cost $35 million, would have to be constructed from the Camiri oil fields to Sicasica. A letter agreement gives Bolivian Gulf an option to finance this pipe line, as well.

The oil pipe line network in Bolivia (mostly six inches) now extends from Yacuina north 160 miles to Camiri; northwest 310 miles to Cochabamba, with a 47 mile, 4-inch Lamboye-Sucre offsheet. West it goes to Oruro, Sicasica and La Paz, some 234 miles. Planned lines include one from Bermejo north to Yacuiba, and the Sicasica to Arica line. In the future, lines may be laid from Santa Cruz south to Camiri and from Camiri to Sucre, Orure and Sicasica.

Glen McCarthy Inc., which holds a concession obtained five years ago in southern Bolivia, recently signed two contracts with firms in Chile, which call for the supply of large volumes of natural gas over 20-year periods. The contracts are subject to, among other things, the construction of a pipe line across the Andes from McCarthy's concession. The cost of this is estimated at around $31 million, to be raised by sale of debentures according to the company's reports.

In Chile there are tentative plans to construct a $1.5 million products line from the recently-inaugurated 20,000 b/d refinery at Concon to Santiago.

A number of oil pipe line ventures are being completed in Mexico. A 50-mile crude oil line of 16 inches diameter, running from Angostura to Veracruz port, is to be completed this year. The capacity is to be 25,000 b/d. A 304-mile products pipe line of 12 inches diameter is being laid from Tampico to Monterrey, to have an initial capacity of 25,000 b/d. The line is so built that the capacity can be doubled.

A new line from Poza Rica to Atzcapetzalco, of 45 inches diameter has been laid to carry 3,000 b/d of propane. An 18-inch line to carry 115,000 b/d of crude runs from Poza Rica to Atzcapetzalco. A trans-Isthmus pipe line, from Minantitlan to Salinas Cruz is being doubled to carry 30,000 b/d.

In Canada construction of the world's largest natural gas pipe line has finally gotten under way with the aid of a loan from the Dominion government. Trans Canada Pipe Lines Ltd. began work with six crews on the Alberta to Winnipeg segment of the line in June and expects to be in Winnipeg before the five-month deadline.

Westcoast Transmission Co. is working on its $153 million gas line from Peace River area to Vancouver to be complete in 1957. Northern Natural Gas Co. has proposed an Alberta to Edmonton to Montana to St. Paul, Minn., line. Britalta Petroleum Ltd. hopes to build a pipe line from the Alberta border to supply gas to Swift Current, Moose Jaw and Regina, Sask.

Cremona Pipe Line Ltd. has approval for an oil pipe line from Sundre-Westward Ho-Harmattan field to Calgary, in competition with Hudson's Bay Oil and Gas Co. and Pembina Pipe Line Co., which proposed lines to Edmonton.

Hydrocarbons Pipline Ltd. expects to build a $35 million 800-mile system to carry oil and gas products from Alberta to Manitoba. Canadian Gulf Pipeline Co. is proposing a $736,000 pipe line of 35 miles from Drumheller oil field north to Big Valley to connect with existing Gulf pipe line to Edmonton, also a 7-mile line from the Burbank field, five miles north to Red Deer and Joffre field to join Interprovincial at Edmonton.

Westspur line in Saskatchewan is under construction. Surgeon Lake line in Alberta's Peace River area is another project. Interprovincial Pipe Line Co. has agreed with British American for extension of its line from Edmonton 150 miles to Clarkson, Ont.

South Saskatchewan Pipe Line Co. of Regina has applied for a permit to construct a line from the Dollard to Cantuar oil field in southwestern Saskatchewan which connects with an existing line running from Cantuar to Regina.

Royal Pipe Lines Co. Ltd. of Regina, plans a collecting lateral system from the Cantuar-Fosterton-Success-Battrum field area, and a 288-mile trunk line to connect with the Interprovincial Pipe Line system at Glenavon.

In Europe a major pipe line is being studied by the Shell Group. The 30-inch line would cost around $280 million and would run from Marseilles in the south to Rotterdam in the north. Capacity would be around 700,000 b/d and the Shell Group would receive the active financial participation of other companies in the Western European market. The project is only in the formative stages, according to the companies, but the savings in transportation costs of Middle Eastern crude would be attractive. If put in at the Marseilles end the saving would be around one-fifth of the tariff for crude from the Middle East via the Suez Canal.

Branch lines would run from the line to Nancy and Paris in France. In Germany the line would connect at Cologne with the proposed Ruhr pipe line from Wilhelmshaven. This line, too, is only in the formative stages.

In Austria, a pipe line is planned between the Bockfliess oil fields and the Korneuburg refinery. Competing political parties have made the date of construction uncertain.

In France the new Lacq field appears to be on the verge of development, with special alloy steels developed to withstand the corrosive effects of the natural gas produced. A network of pipe lines is planned for France when the project gets underway, although plans have not yet been announced.

Germany is still studying West German Esso's plan to build a crude line from the Ruhr near Cologne to Wilhelmshaven or Rotterdam. The company proposed to contribute 40% of the cost.

Another project is currently under consideration for a new gas pipe line from Italy's northern gas fields to West Germany's industrialized south, going from Lombardy to Bavaria and crossing Austria in Tyrol province via the Brenner Pass and Innsbruck. A second line would later enter Austria in Carinthia province, cross Styria, lower and upper Austrian provinces to connect with a north Bavarian pipe line system.

A products line is being built in Greece at present, to connect the refinery under construction at Aspropyrogos on the coast with Athens, some 15½ miles away. Cost of the line to the 26,000 b/d refinery is estimated at $1,178,000.

Gulf Italia, the Gulf subsidiary that discovered oil in Sicily, recently completed its 12th well in the Ragua field and is now working on a pipe line from Ragusa to the

Because large equipment could not be transported to the scene of construction, the constructors had to design new mobile apparatus. Shown is the rubber-tired mobile pipe bender developed by Williams Brothers, Tulsa, and pulled the length of the mule trail. (Photo courtesy of Williams Bros. Co.)

This portion of the old mule trail used in Columbia's Oleoducto del Pacifico product line was lost beneath an avalanche of rocks and had to be re-opened by hand. The almost-vertical rock wall in the background above the trail is indicative of the sheer drop-off below it to the Dagua river. (Photo courtesy of Williams Bros. Co.)

refinery at Augusta which is estimated to cost around $4 million. The line will be completed during late 1956, according to reports, lifting the Augusta refinery runs to around 5,000 b/d.

In Spain the only important pipe line is the project linking the Atlantic seaport of Rota by means of a products line with the five bases currently under construction. The line is being built by NATO and is a joint venture of Brown and Root, Inc., Raymond Concrete Pile Co. and Walsh Construction Co. The line will cut diagonally across the Spanish peninsula from Rota northwest to Zaragoza, site of a big U.S. bomber base.

In Eastern Europe the pace of pipe line construction is rising rapidly. Russia has begun a tri-weekly pipe line publication called "Pipeline Construction." The first issue states pipe line additions during 1955 were 975 miles. About 5,589 miles of gas line are scheduled under the new Five Year Plan. Pipe line throughput is to be raised to 83,000,000 metric ton-kilometers, about 600% over 1955. New gas lines are to be laid between Stavropol-Moscow, Dashava-Minsk-Leningrad, Stavropol-Nevinnomysk-Mineralrye, Vody-Grozny, Shebelinka-Kharkov-Kursk-Orel-Bryansk, Kazan-Gory and additional work is to be done on the Berezovo-Sverdlovsk and Grosny-Tbilisi lines.

The only pipe line under consideration in Africa is that proposed in South Africa. The sharply-rising demand for oil products has caused increasing strain on railways which is worsened by a government prohibition on road transport outside a radius of 30 miles from a bulk storage depot, a measure designed to protect the railroads. An inland pipe line would effect considerable savings and is being actively considered by a government commission, which recently heard plans for a 12-inch 500-mile line to cost about $33.6 million.

The Middle East has several pipe line projects going. In Iran the National Iran Oil Co. took over the problem of internal supply from the Consortium and has incurred an annual deficit on this account since. Movement of finished products from the refinery to Teheran has been by rail tank car at considerable expense. Work is therefore in progress on construction of a products line from Ahwaz to Teheran. Total length is 590 miles, diameter is 10 inches with an annual capacity of about 40,000 b/d of products. Construction is by Richard Costain-John Brown Ltd. of London, with the Azno to Teheran portion awarded to the French company of Soc. Entropose. Stewarts and Lloyds are supplying the pipe.

Iraq Petroleum Co. announced the planned construction of a new 24-inch pipe line to Tripoli from a point east of Homs in Syria with about 187,151 b/d capacity. Another project is the diversion of the Haifa lines to Sidon in Syria and a crude line to Kuwait's Mena Al Ahmadi terminal. Both the latter projects are now at a standstill, according to reports.

In Saudi Arabia four new turbine pumping units are being installed on Tapline, to increase capacity to 410,000 b/d. This is under the maximum capacity of 500,000 b/d of the line.

The completion of a four-mile pipe line in Israel from the recent Heltez discovery to the railhead at Askalon has permitted production of the wells at about 300 b/d. If the field proves to be worth the cost, a pipe line may be run directly to the coast and to a marine terminal.

Elsewhere in the Middle East Turkey has begun construction on two more products pipe lines to serve military airfields belonging to NATO. Cia. Technica Internazionale of Milan is building the lines. Both will terminate at Eskisehir, about 140 miles west of Ankara and in upper north-central Turkey. One four-inch, 205-mile line will begin at Bandirma, on the sea of Marmara, the other will be eight inches diameter and begin on the Mediterranean at Antalya, almost due south of Eskisehir which is 250 miles away. Still another line is being built by Associated Pipe Line Contractors of Houston, running some 425 miles from Iskenderun to Batman where the new refinery is located. The line will be four, six and eight inches diameter.

The successful completion of the Sui gas line to Karachi in India in 1955 has brought a second gas pipe line project, this time from Sui fields to Moultan, 188 miles away. The 16-inch line will be built by Pakistan Constructors, a joint company of Morrison-Knudson of Boise, Idaho and William Press Ltd. of London. The same company built the 16-inch, 350-mile Sui line to Karachi. The Moultan line will be extended to Lahore later with branches of Kot Addu, Montgomery, Jhang and Maghiana.

Two pipe lines are planned in Indonesia. Standard Vacuum Oil Co. is building an unusual 88-mile crude line from the Lirik field to Buatan. The problem in transportation of the crude is the high paraffin content of the oil which has given it such a low pour point (around 105°F.) that the line has to be heated to prevent freezing. To keep up temperatures, the company built hot water pipes around the upper third of the well (below ground temperatures are about 166°F.) and have heated the oil to about 153°F. every 18 miles along the 8-inch, 20,000 b/d line.

Until the line is finished, in 1958, the crude is being shipped through an existing 6-inch line to Djapura on the Indragiri river. There it is put into shallow-draft barges equipped with heating coils and shipped 35 miles to Tjenako for loading on ocean-going tankers.

Another pipe line in Indonesia is being planned by Caltex. At present production from the company's Minas field, the outstanding recent discovery in Indonesia, is being piped to a nearby river and loaded on special river tankers for delivery to a marine terminal. A pipe line is now being planned from the Minas field to a marine terminal which will permit higher production rates. Size and capacity of the planned line have not been revealed. END

RED CHINA
a rising Oil Star?

The accompanying article is the first of a series which will appear in WORLD PETROLEUM *in coming months. The series will be based on surveys of Soviet and satellite literature by Dr. Rosu and on interviews with communist oil executives and personal visits to Russian and other communist oil fields and installations by the editor of* WORLD PETROLEUM.

By Dr. G. G. Rosu

DURING the current Five-Year Plan (1953-1957), China hopes to more than treble her crude oil production. Her more distant goal is to outstrip Romania and become, by the end of the third Five-Year Plan (1967), the second largest oil producer in the Soviet orbit.

A more rapid development of China's large oil reserves is hampered by her industrial backwardness. The industrialization program, however, as reflected in her first set of three Five-Year Plans, is extremely ambitious as compared with her very modest investment rate. China is frantically pushing collectivization of her 500 million peasants in order to create additional investment means. In the meantime, she is using millions of bare hands as a substitute for machines. To further her industrialization, Russia and Eastern Europe are committed to grant China substantial long-term credits and multifarious assistance for many years to come.

On the theory that oil can be produced in volume approximately proportional to the volume of sedimentary deposits in basins of petroliferous age, China may be assumed to have fair prospects for the development of substantial oil production. China's sedimentary area covers approximately one million square miles. Her more important basins are:

1. *Dzungaria Basin*, bordered bv the Altai and Tien Shan ranges, is, at present, the most prospected and drilled basin in China. This region was discovered in 1933 by Russian geologists who completed a study of its asphaltites. There are frequent oil seepages here, and oil has also been found in Jurassic continental deposits. Dzungaria's oil deposits are of considerable value. Production is, however, limited to Urumchi (Tihwa) and Wusu fields because of lack of transportation. Prospecting activity is reported to be carried north of these oil fields to Tahcheng and up to the southern borders of the large Cerny Irtysh shale deposits.

2. *Tarim Basin* underlies the barren and desolate Takla Makan desert, and is flanked by the Tien Shan and Kunlun Shan mountain ranges. Its geological conditions are little known, but its potential is, none the less, very favorably assessed. The only access to this basin is from the Great Silk Road which branches off at Ansi, and nears it from north and south. It is along these access roads that prospecting and drilling activity is carried on. Oil findings have been recently reported on the northern border, from east to west, at Kurla, Kuche, Aqsu and Kashgar. Romanian engineers and drillers have been working with Chinese teams at Wusu and Aqsu during the last two years.

Development of the mineral-rich Sinkiang Province, where these two basins are located, will be retarded until the railroad connecting Lanchow-Yumen-Urumchi with Aktogai on the Turkestan-Siberian line is completed. By an agreement signed in Peking last April 7, Russia undertook to finish the track on her territory before 1960.

3. *Tsaidam Basin* covers the marshy area enclosed by the Nan Shan and Kunlun Shan ranges which lies at an average elevation of 10,000 feet. Geological conditions here are also little known, but oil seepages occur on the basin's southern border. There are no reports of any current drilling activity in this area.

4. *Shensi Basin* extends northwards into Inner Mongolia. Its geological conditions are fairly well known. Frequent oil seepages have been reported. Shensi's economic prospects are favorably assessed.

5. *Szechuan (Red) Basin* is fairly well known geologically. There are several oil and low-pressure gas seepages occurring along its borders. Chinese official sources claim that extensive geological activity is being carried on in this basin. Soviet sources have disclosed that a rich field has been recently discovered here, and is now being developed.

6. *Kansu Corridor* is one of several smaller Tertiary basins with favorable geological features in the east and north China's main producing field, Laochunmiao, near Yumen, lies in it. The Kansu Corridor is a narrow inter-mountain basin, southwest of the Gobi Desert. The Laochunmiao field in this basin is producing at the rate of 20,000 b/d, which represents almost 75% of the nation's current crude oil production. As China's only pipe line will soon connect Yumen with Lanchow, a substantial expansion of the former's output is to be expected during the second Five-Year Plan (1958-1962). Oil findings were reported also in the north of Tsinghai Province which lies west of Yumen. A big refinery is being built at Lanchow. Therefore, Yumen-Lanchow is planned to become Central China's main oil supplier and, possibly, of the east coast, as well. As indicated on the accompanying map, this oil region is now connected by railway with Peiping and Dairen in the north, with Shanghai, as well as with the Han Cities in the south.

7. *Tientsin Basin* is located on the shores of the Yellow Sea. During the last war, Japanese geologists drilled in several locations along the coastal railway from Fuhsien to Fusin (coal basins) and thence westwards to Chengteh (Jehol). It was claimed that eight deposits were found by 1943 but this claim was never followed by any serious development drilling.

Reserves: As the geological conditions of China's basins are only partially known, it is very difficult to correctly assess their prospects. Data available at this moment suggests that the richest structures are those of the Dzungor Basin and of the Yumen-Tsinghai region. China's possible reserves are assessed as follows:

	Millions of Barrels	
	1949 (a)	*1953 (b)*
Dzungaria Basin	870	N.A.
Tarim Basin	500	6,700
Kansu Corridor	430	430 (c)
Shensi Basin	2	2
Szechuan Basin	—	435
Tientsin Basin	—	145
Remaining Basins	65	—
	1,870	7,712 (b) (d)

(a) According to the last report published by China's Bureau for Assessing the Mineral Wealth of the National Resources Commission.

(b) Figures reported on Aug. 18, 1953, by the New China News Agency, and printed in Pravda of Aug. 19, 1953.
(c) Following the Tsinghai oil findings in 1954, the Kansu Corridor's reserves must be considerably higher by now.
(d) However, the Taipeh Government assessed China's prospective reserves in 1953 at only 2,580 million barrels. As the "prospective reserves" are not further defined, it is difficult to assess the Taipeh figure.
N.A.—Not Available.

There is no official estimate of proven reserves, but they may be conservatively assessed at 400 to 500 million barrels at the end of 1955.

If these comparative figures are taken at their face value, the conclusion is that China's possible reserves more than trebled during a four-year period. This may be due to the Sino-Soviet agreements of Feb. 14, 1950 which mapped out an ambitious prospecting and exploration program. The joint Sino-Soviet oil company (disbanded last December) intensified the search for new deposits, particularly in the Sinkaing Province.

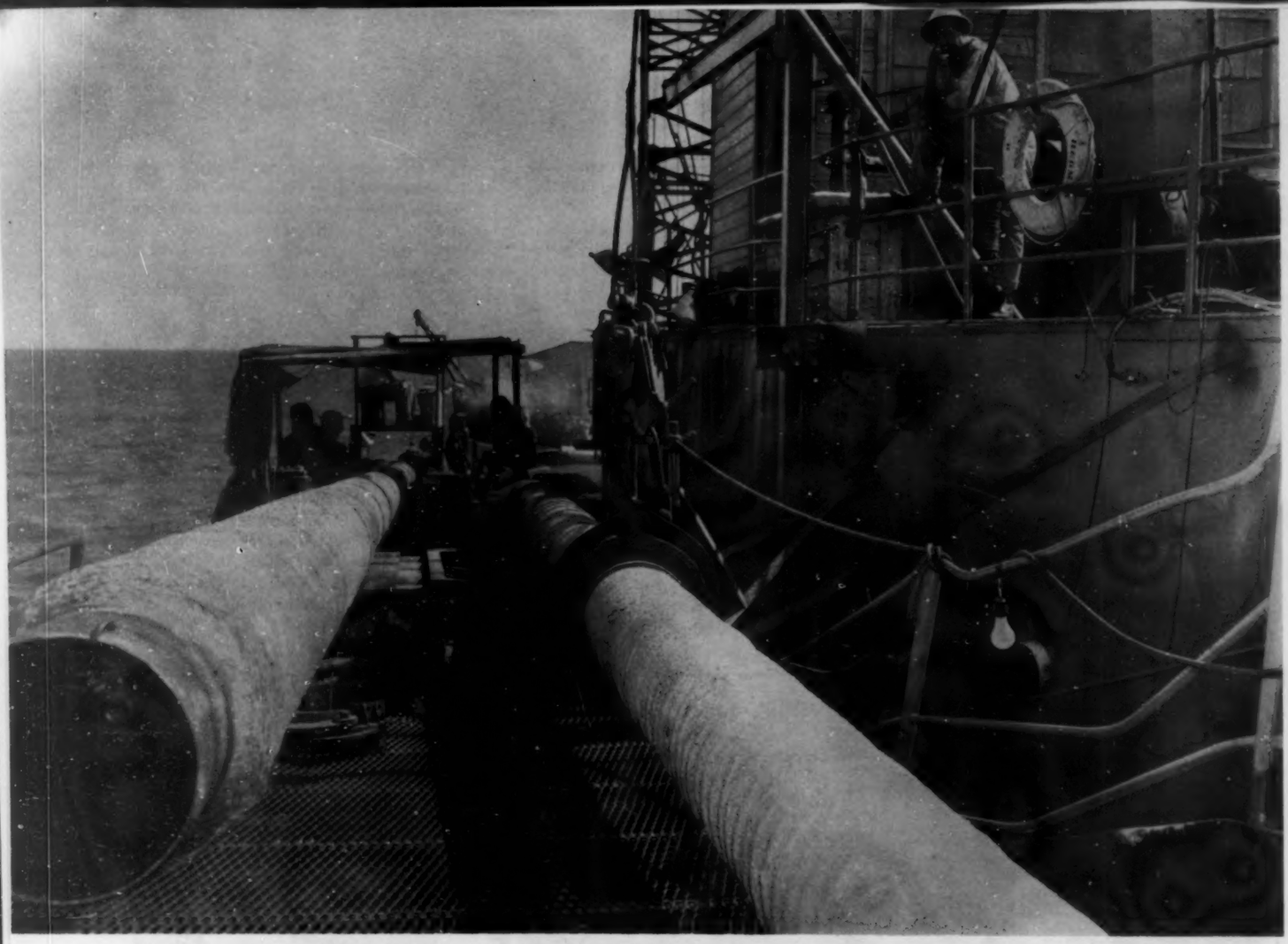
Drilling: As it is customary for the whole Soviet orbit, China's drilling activity is revealed only in percentages. These sources reveal that the volume of geological prospecting carried out in 1952 was two-and-one-half times higher than the pre-war level while, in 1953, this activity increased tenfold as compared with the previous year. From 1952 on, drilling activity is said to have been on a year-around basis. In view of Sinkiang's harsh climatic conditions, this is a notable feat. The shortage of drilling equipment implied in this statement should not be overlooked.

As to operating rigs, their number in 1952 was officially put at seven times pre-war. Whatever this increase may actually mean, it is safe to assume that China probably has a substantial number of rigs in the field today. Russia, Eastern Germany and Czechoslovakia did not begin volume deliveries of drilling equipment until after 1953. In addition to technical assistance, Romania has become a major supplier of drilling equipment since 1954. According to a brief news report of last January, Romania will supply China in 1956 with 22 complete "oil installations," which may include also several rigs. By the terms of the April 7 Sino-Soviet agreement, Russia will give China more help in the future for expanding the latter's geological prospecting program.

China herself started production of drilling equipment at the Mukden Works last year. Production of tubing has been increased since the recent opening of the tube section of the Anshan metallurgical works.

From official percentages it may be assumed that drilling activity in China is given first priority. In 1952, 76% of all funds earmarked for the oil industry were

(*Continued on page 89*)



Section of concrete-covered line pipe is lifted into place for welding aboard the Brown & Root, Inc. laybarge, "Herman B," a converted LST which performed the continuous operation of x-raying, priming, doping and wrapping pipe, cementing the joints and lowering pipe into the water.

Politics, Weather and High Costs Complicate Offshore Oil Gathering

By James W. Calvert

Most offshore oil from producing fields in the Gulf of Mexico is moved to market by barge at costs ranging up to 50 cents per barrel. One forty-eight-mile pipe line has been laid.

The potentially rich offshore oil fields of the Gulf of Mexico extend from Brownsville to the mouth of the Mississippi River and, in places, as far as 75 miles seaward.

For 20 years oilmen have eyed this waste area, and the cost of their exploration has reached into the billions of dollars, with the return to date amounting to an infinitesimal fraction of the total outlay.

Today, the underwater production of the Gulf of Mexico runs to a bare 60,000 barrels of oil daily, but the majors who are taking the lead in the offshore development are looking to the day when the Gulf may well become the world's greatest producer of petroleum.

Offshore production and gathering is a costly and complicated procedure, and the men who go down to the sea for oil and bring it back to shore are faced with obstacles which make conventional production methods seem tame by comparison. The twin menaces of weather and sea are the least of these problems. The rising costs of steel and the bickering between political groups and subdivisions over ownership of the tidelands and of the minerals that lay beneath them are further complicating the efforts of the petroleum industry in developing the valuable underwater oil and gas.

The gathering of offshore oil by barge is a never ending process that is increasing steadily as new fields are developed. Oil producers foresee a time when the Gulf of Mexico may be criss-crossed with an intricate system of underwater pipe lines, but that time is so far in the future that the barge will be the principal method of transportation for many years to come.

Present underwater pipe lines are confined to areas close in shore, or constitute relatively small gathering systems between wells in offshore fields. The larger of these fields flow into a central production platform, from whence oil is collected by barge and transported to pipe lines ashore or directly to Gulf Coast refineries. Only Magnolia Petroleum Co., with its 48-mile underwater line off the Louisiana coast at Morgan City, attempts pipe line transmission of oil for any appreciable distance.

For the most part, wells are allowed to flow directly into collection barges from which transportation barges collect the production. Some of the larger, multi-well offshore platforms have their own limited storage facilities and a few of the companies have been experimenting with submerged tank batteries.

It costs from 25 to 50 cents per barrel and upward to transport oil in this fashion, depending upon the distance from shore and the number of producing wells in a single field.

Since most of the offshore operating companies are now concentrating on the validation of their expensive leases rather than upon production development, most of the wells are widely separated and hence the cost of gathering oil is proportionately higher.

One company, with most of its producing wells located within ten miles of a pipe line terminal ashore, estimates the cost of transportation at 25 cents a barrel, for both water going out and oil coming in. On the other hand, another of the majors with its production scattered over a larger area of the Gulf, estimates the cost of tug hire alone at 40 cents per barrel of oil, in addition to barge rental at the rate of $2,500 per month per barge.

This company uses 8,500-barrel seagoing barges for collection purposes, leasing them from independent barge operators. In 1939 this same barge could have been built for $17,000. The last one delivered in 1956 cost the owner $82,000.

An indication of the rising cost of barge construction, which has a direct bearing upon the cost of offshore oil gathering, is shown in the comparative prices for a standard 110-foot deck barge, which is used extensively in offshore operations. This particular type of equipment is used because it contains exactly 100 tons of steel.

Comparative costs of this barge, by years, follows:

1940	$10,000
1948	18,000
1950	20,000
1955	23,500
1956	25,000

This is in direct proportion with the steel index over the same period of time, beginning with 1940 at 100%. The steel index for the comparable period was:

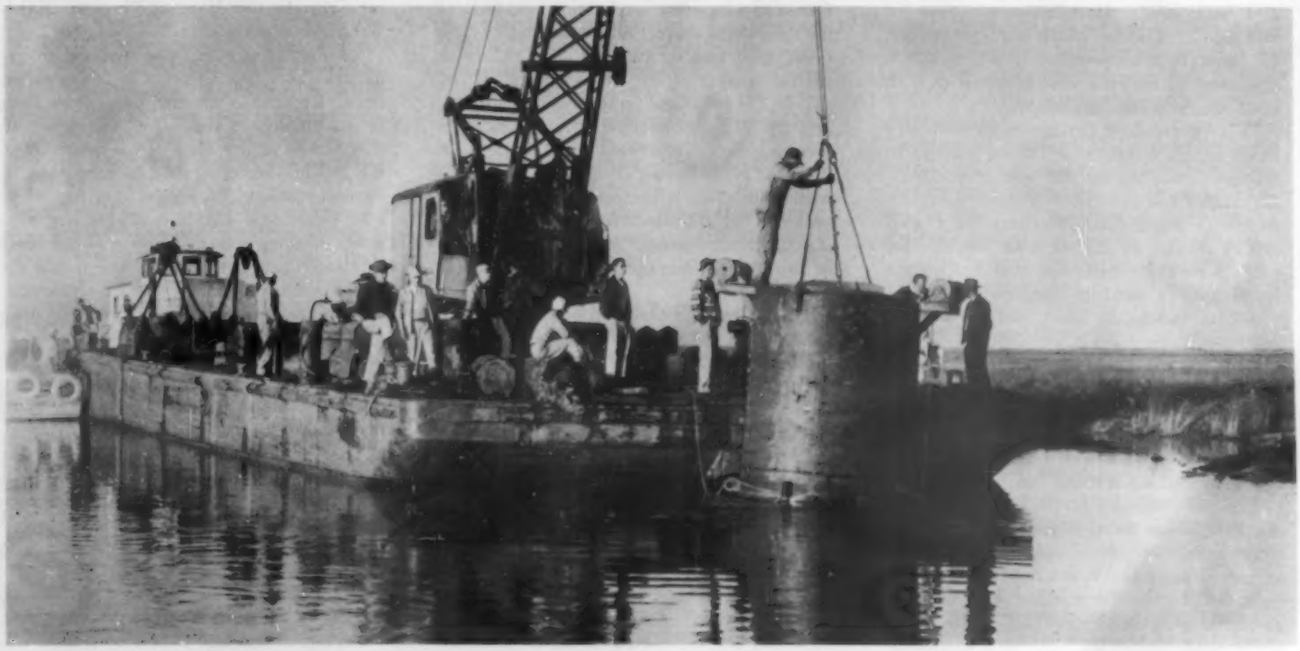
1940	100%
1948	147.8%
1950	193%
1955	215%
1956	225%

Offshore allowables are considerably higher than that for wells on shore, but even with an allowable of 350 or 400 b/d a well requires better than 20 days of rental time to fill an 8,500-barrel barge. Add to this the rental of a seagoing tug at $600 a day or more, with an additional $300 per day standby, and the cost of hauling the oil to a refinery or to a pipe line terminal takes a good "hunk" out of the sale price of the oil.

One company with a producing well 60 miles at sea would, at that rate, be paying just under $1.00 per barrel for transporta-

Valve of the underwater pipe line is fitted into place aboard the laybarge.

"Bell' is used for repairing leaks in joints of underwater pipe line. The jacket is placed over the pipe seam so workers can repair underwater leak.



tion (21 days of barge rental at $80 per day, one day's rental of a tug at $600, plus 20 days standby time at $300 per day). This particular well is the first to be drilled from a 12-well platform. As additional wells are completed the per barrel cost of transportation will be materially reduced.

Most companies having producing wildcat oil wells within a general area of the Gulf keep flow barges on a semi-permanent moorage and collect the oil from these into a single barge making daily rounds of the wells.

Such an anchorage, originally designed by Capt. E. R. Vorenkamp, marine superintendent of Shell Oil Co., has been adopted by most of the other companies. This consists of a doughnut shaped buoy, anchored some distance from the platform and connected by pipe line to the well. A flexible hose from the pipe line extends through the center of the buoy so that a moored barge will swing around the buoy, always "holding its head" to the sea. A collection barge taking on crude oil will simply moor to the flow barge and ride with it while pumping.

Captain Vorenkamp devised the "doughnut" buoy when it was found that many vessels were being unduly pounded against the permanent drilling platforms while laying alongside to collect crude oil.

The same type buoys are now being used to discharge cargo and personnel from supply and crew boats to the drilling platforms. As the vessels swing around the buoy, keeping headed into the sea and wind, the cargoes can be taken aboard the platforms by means of a high line while fuel and water can be pumped aboard through flexible loading lines.

The method of allowing a well at sea to flow into a barge or into its own limited storage facilities is fine so long as the weather remains relatively calm. The Gulf of Mexico has a nasty habit, however, of kicking up squalls which sometimes last for days. In such weather it is impossible to gather oil and the well must be shut in until the weather moderates.

"We haven't had enough experience offshore to know just how far we can go in trying to maintain normal operation during periods of bad weather," one oil company executive explained. "Shutting in a well can be costly, as any oil man knows. Not only do we lose production time but we are faced with a sand problem which might result in having to work over a well to get it to flowing again.

"But we are too inexperienced to take chances. There has not been a repetition of the 1947 hurricane since we've been operating in the Gulf. Some day there will be, and then we'll know just how much our men and equipment can take."

The most efficient method of oil gathering in offshore fields appears to be in the construction of production platforms, and as more fields are developed these structures will increase in number. Ideally, such a platform would serve all wells in a single field, linked together by a gathering system of pipe line extending from the wells to the production structure.

Magonila Petroleum Co.'s production platform off Eugene Island, which serves a 48-mile pipe line to the mainland.

Several platforms already in operation generally are patterned after the structure erected in the Block 126 field, off Eugene Island, by the Magnolia-Continental-Nemount combine.

Such a structure costs approximately $1,500,000 and consists of a central separator platform, oil storage platform, combined pump and compressor platform, and a living quarters platform. The oil storage platform is a 12-pile structure designed to support two 5,000-barrel oil storage tanks. The deck is 50 feet by 100 feet. The separator platform, 98 feet by 136 feet; the 72 by 141-foot pump and compressor platform, and the 44 by 87-foot living quarters platform are tied together by a system of bridges, each having a span of about 90 feet. This gives a clearance between each structure of approximately 80 feet, resulting in greater safety in the event of fire or unforeseen damage to any given structure.

The oil storage platform of the Magnolia structure is placed on the westerly side of the group. This location was selected after a careful study of prevailing winds and velocities. In this area, the prevailing wind direction over a major portion of the year is southerly, southeasterly, easterly or northeasterly; hence the location of the storage platform provides the maximum safety to adjoining structures in case of fire.

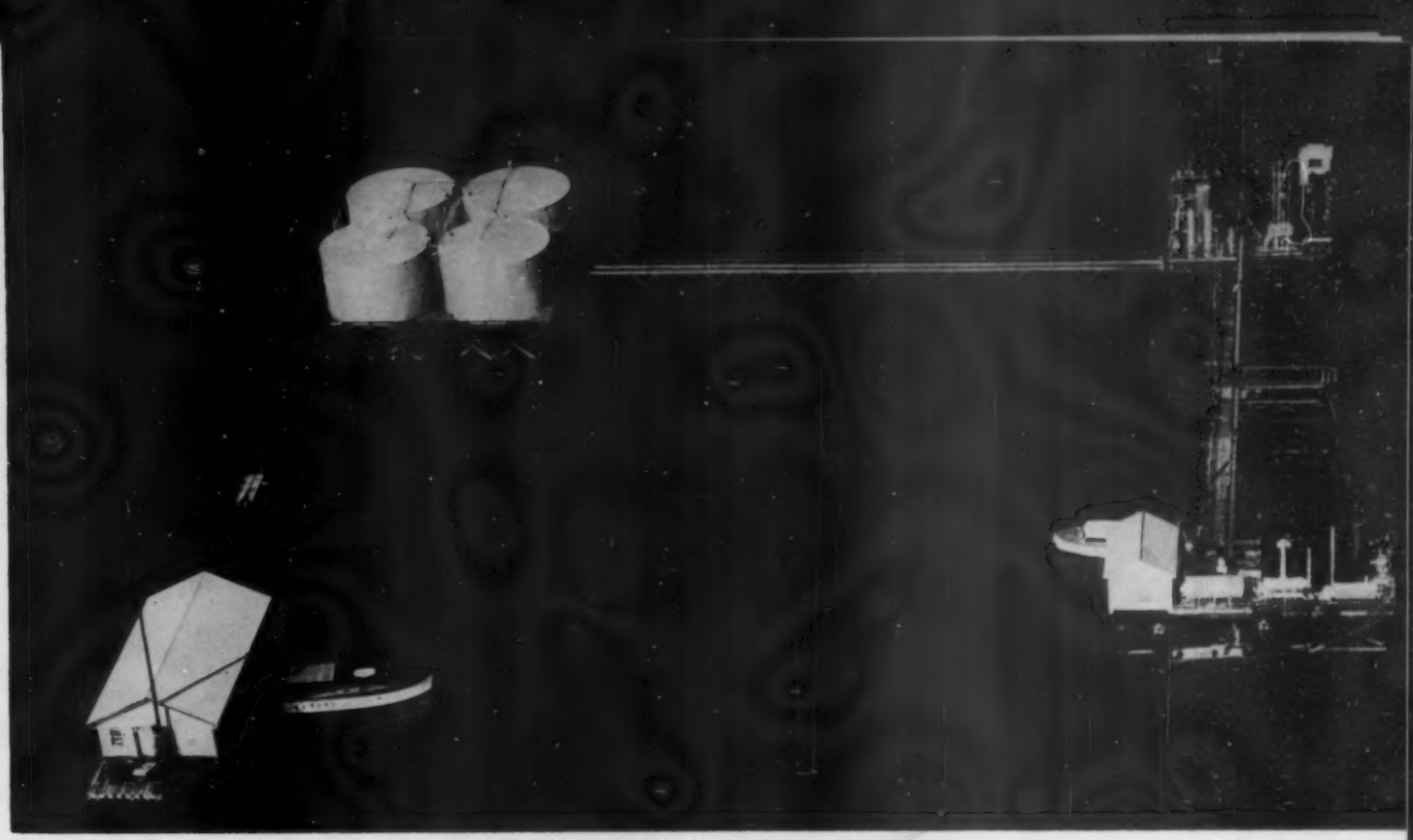
While some close inshore oil fields as Bay Marchand, and some gas fields off the Louisiana coast near Morgan City and Cameron are connected to shore lines by underwater pipe lines, only the 48-mile pipe line of Magnolia-Continental-Nemount syndicate extends a considerable distance at sea. The MCN group found that when production in the Eugene Island area reached an approximate peak of 6,000 b/d, the high-cost-per-barrel of barging oil to shore could be reduced by construction of a 12¾-inch line to flow both gas and oil.

The line was routed between the production station at Block 126 and the Burns Plantsite on Bayou Sale, juncturing with other production lines at Platform No. 51. The main line thus forms a "dog-leg."

Routing of the line was planned to give as straight a line as possible between stations. Because a marine borer was found in the vicinity of Block 126, the entire line was buried in the floor of the ocean. While the marine borer is able to bore into the concrete jacket of the pipe line, it does not live below the silt line. Thus, the engineers decided, a buried line is out of reach. The fact that cover on the line would also afford some protection against dynamiting by exploration crews and against the dragging nets of shrimp trawlers, also influenced the decision to bury the line.

Concrete coating of the line serves a dual purpose. It provides protection of the pipe as wel as the required negative buoyancy. A pipe line of eight inches or more will float, the engineers say, and must be held in place by weights. They tell the story of a diver who was trying to locate a pipe line at sea to make necessary repairs. After crawling along the floor of the ocean, "feeling" for the line, he stood upright and the top of his helmet struck the pipe.

Laying of the line was a long and diffi-



Humble Oil & Refining Co.'s offshore production platform.

cult task, requiring more than a year to complete. Work commenced on Sept. 24, 1954, with Brown and Root, Inc., of Houston, as the prime contractor. The line was built with two spreads; one shallow-water spread working in the bay area, and one deep water spread working in open water.

In the bay area a ditch was dug with draglines mounted on barges, the pipe was laid and the ditch filled. On portions of the line outside the bay areas the pipe was laid first and then ditched down with a jet-suction dredge.

Work was continuous along the pipe line until the pipe was welded, x-rayed, primed, doped and wrapped, the joints concreted and the pipe lowered into the water. After laying, a diver inspected the pipe for damage to the coating and took soundings to determine if the pipe was at the required depth.

As is the case with most offshore operations, weather was the controlling factor in the construction of the pipe line. Weather causing waves of four feet in heighth produced so much movement of the pipe that it was impossible to make a weld.

With such obstacles in the way of pipeline builders at sea, it is not difficult to realize the enormous costs represented. For example, a three-inch pipe line in shallow water costs approximately $2.50 to $3 per foot, with an additional 50 cents per foot for a four-inch line.

A six-to-eight inch-line in deep water will cost an estimated $10 to $13 per foot; in the case of the latter size, which ordinarily runs $12 per foot, an additional $1 per foot is added to the cost because of the need for concrete anchors, spaced at regular intervals, to keep the line in place on the bottom of the ocean.

Maintenance of a pipe line at sea is proportionately costly, from a dollar-and-cents standpoint, and dangerous from the standpoint of the men whose job it is to keep it in a state of repair.

A dynamite blast from a seismograph boat, an ill-aimed anchor, or a dragging shrimp trawl can do the damage. The pipe line is at the mercy of all. A rupture in the line probably would first be detected by a drop in oil pressure or the appearance of an oil slick on the surface of the water. Immediately the line would be shut off and a diver sent below to "walk" over the suspected area in search of the break.

Once found, the pipe line would be brought to the surface by a derrick barge and the ends spliced together. For these reasons, many oil executives believe that the general use of pipe lines in gathering oil at sea will be long in fulfillment.

One company, the Offshore Gathering Corp. of Houston has proposed plans for the construction of a dual transmission line from Sabine Pass, near the Texas-Louisiana border, to a point near the Louisiana-Mississippi border. This, they say, would be laid approximately 25 miles from the shore line in water ranging from 40 to 60 feet and would extend for a distance of approximately 364 miles.

Some executives question the value of such a line from the standpoint of transporting oil. They contend that with the availability of inland waterways in South Louisiana and Texas, it will always be more feasible to use barges than an underwater pipe line to haul crude to the various refineries situated in the two-state area.

Others feel that the line, if constructed, will overcome a major transportation problem and would stimulate future oil and gas development in the offshore areas.

Obviously, a pipe line gathering system will be necessary to serve the increasing number of gas fields being developed in the Gulf of Mexico. Most gas wells are now shut-in because pipe lines are not available. One company has recently contracted for the laying of 18,000 feet of line to serve several newly completed gas wells and the gas transmission companies are offering to build a mile of line for each four billion cubic feet of gas reserves found in the offshore areas.

Flaring of gas from producing oil wells in the Gulf is a rare sight to behold. Ship masters approaching the mouth of the Mississippi River say the glow of the hundreds of flares dotting the coastal waters of the Gulf can be seen for scores of miles at sea.

"We no longer need to look for the light at South or Southwest Pass to know we are nearing the mouth of the river," said one ship master. "Now we can see the flares from the oil fields many hours before we pick up the lights."

Oil companies are careful to pipe gas for flaring a good 200 feet from the rigs. For ignitors, most crews fire Very pistols, more commonly used to send distress signal flares by ships at sea.

However, one purchasing agent had a better idea.

He sent out a load of Roman candles.

Its a lot more fun. Sort of like celebrating the Fourth of July—every night. END

MODERN

Someone, obviously not a pipe liner, long ago defined a pipe line as a "tube of rusty steel sometimes bringing raw crude oil from the oil field to the point of first improvement—the refinery." Also, a quarter of a century ago, a pipe liner was characterized as a man with a "strong back and weak head." The first attribute was required for the grueling task of "wheeling" a main line gate by hand and the second because he lacked perception enough to get out and find a better-paying and less exacting job. Today, with the vast improvements in pipe line equipment, the pipe liner needs at most a good index finger—either hand—and 20-20 vision.

With the development of pipe lines from the time when a 10- or 12-inch line was considered big, and anything above the latter diameter was labelled "Big Inch" and a rarity, crude oil trunk lines nowadays are common in the 24- to 30-inch sizes. Lines of such diameter require valves weighing up to 12 tons, and it is evident that such units cannot be manipulated by hand—nor would hand closing meet an emergency, with upwards of 350 turns of the handwheel being required in the case of at least one 3-inch valve from full open to full closed. Plug valves for lines of such size require such torque for operation that it is difficult to get men around the valve to move it manually against normal line pressures—although the chore is easy for any modern power-operated closure.

The pipe line, in the past 25 years, has

Two men lower a tapping machine into the caisson for making a tap into a pipe line 20 feet below the waters of the Gulf of Mexico. Valve and saddle are already in place.

Automation has simplified the job of operating a pump station and its remote satellites and maintaining continuous

PIPE LINE OPERATION

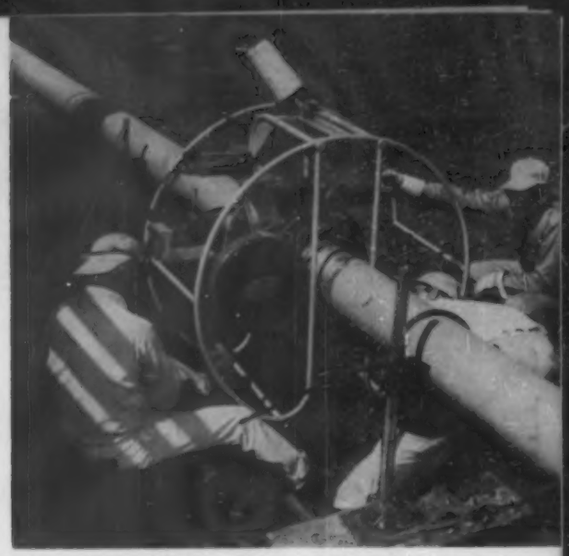
completely outgrown the men who used to control it manually. It has been made possible only because of the perfection of adequate mechanical aids.

The multiple-line system has been replaced in most instances by single large-diameter lines; and with this change has come a like switch from many individual pumps to a few large capacity units. Motor driven pumps with electric motors of 1,800 hp are used to drive high-volume centrifugal pumps, and internal combustion engines ranging up to more than 3,000 hp are being employed to power two or more centrifugal pumps through step-up gears to obtain the desired rotor speed of the pump impeller. With the decrease in number of units for a given throughput has come a consequent reduction in the over-all manpower required to operate the typical station. Removal of the prime mover portion of the station from the station yard to a central powerhouse—in effect the case when purchased electric power is used to turn the pump motors—removes the need for men who formerly were required for operation and maintenance of the many internal combustion prime movers. Even with the shorter work week and shift-breaker crews a line operates with but a fraction of the station personnel of its prototype of two decades ago.

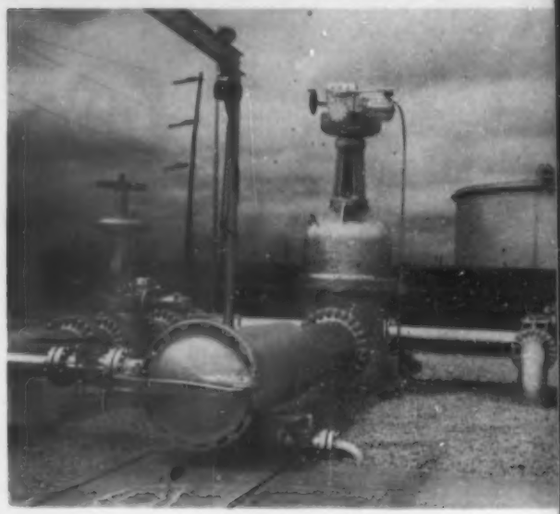
One of the relatively small—so far as actual size is concerned—changes which has brought about wide application of multi-stage centrifugal pumps in pipe line operation is the development of the mechanical shaft seal to the point where it can be run unattended. In the hand-operated days of pipelining, maintenance of either plunger or shaft packing was one of the principal chores of the station engineer. The problem of packing leakage was met in part by the installation of elaborate sump systems and adherence to the principle that a certain amount of flow past or through the packing was necessary to its lubrication and, hence, to its service life. The sump today is largely only an emergency provision, and where provided with automatic devices for pumping, is checked only at widely spaced intervals.

In the days of the multiple line systems, every effort was made to prevent mingling of one type of throughput with another, and separate tanks were installed at each station to handle the "over and under" fluid as changes in the line conditions made it impossible to maintain flow of the entire volume of any given crude through the system. Each pipe line, instead of being an integrated system as it is today, was in reality a number of individual lines, laid end to end, each one receiving into its tanks from its predecessor as it could deliver, and in turn repressuring the fluid as it drew from its own tanks and forwarded it.

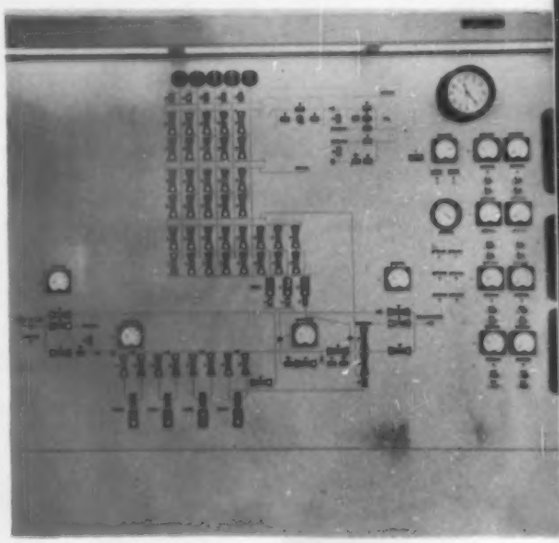
The pipe line today is a common carrier, in effect as well as by interpretation of the Interstate Commerce Commission. Batching of throughput has been developed, to the point where now it is not uncommon for a trunk line to have as many as 30 different consignments in transit at the same time, with the entire fluid column moving from the initial station to the ultimate tank farm without once being withdrawn from the line. The only portion of the stream which may not reach the purchaser's tanks with-



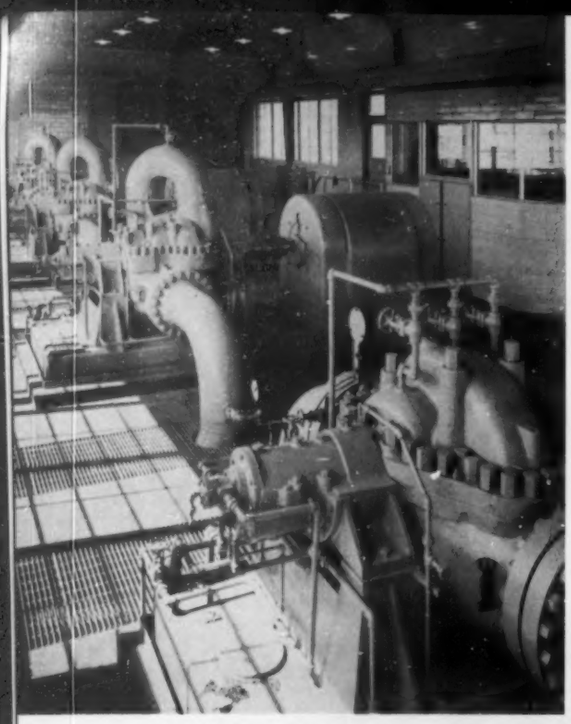
Welders with special head join 8-inch aluminum pipe in a line so light ordinary automobile jacks are used for leveling the joints preparatory to joining them.



Scraper trap and massive control valve required on a modern crude oil tank line. Note enlarged barrel of scraper trap to facilitate entry of "pig."



Diagrammatic panel board for a main line station, with lights which indicate line conditions and which are equipped with check lights for testing system without affecting line indications.



Four modern electrically driven centrifugal pumps in a large-diameter crude oil station. The control room is at left, totally isolated by glass panels.

out once being stopped in its progress from the initiating station may be a small cut at the interface between two dissimilar batches of fluid. This cut may be "downgraded" by the pipe line and delivered with the batch which carries the lower classification, or it may be held in a slop tank until sufficient quantity has been accumulated to form a slug for refinery handling.

In products lines the handling of batches of various characteristics has become a science, with widely different products being sent through the same line without affecting the quality of any. The use of a crude line for products pumping, or of a products line for handling crude, however, still leaves much to be desired. One pipe line which forwarded a crude tender through a products line found that it required the pumping of approximately 200,000 barrels of products through the line after the crude shipment before color specifications could be met with the product.

The determination of interfaces between batches in the pipe line has progressed through several avenues of approach until the pipe liner now can determine them with pinpoint accuracy—provided the throughput has remained in motion while within the line. Gravity commingling is a problem still vexing the pipeliner if his line is across hilly terrain and is shut down for an appreciable length of time. But if the critical velocity of the stream can be maintained the amount of mixing of adjacent fluids can be kept to a minimum, and the approach of such an interface to a station, junction, or take-off point can be signalled to the operator or dispatcher in time for appropriate action to be initiated so as to receive the cut with a minimum of contamination or loss.

Use of radioactive isotopes for interface determination, in which short-life isotopes are introduced into the stream at the initiating station, permit the long-range measurement of the throughput travel with detectors simply attached outside the pipe wall. By means of electronic counters such indication of interface approach can be relayed to the central office of the pipe line sufficiently far in advance of the actual arrival of the interface at a given point to trigger a line or tank change without even decreasing line pressures. At least one pipe line company, running experiments looking to the automatic switches of batches at its terminal, has progressed to the stage where the transfer takes place without human intervention—and the only check comes in the sampling and gauging afterward for the stock records of pipe line and receiver.

Metering of pipe line throughput, when combined with automatic or remote gauging devices, has removed or greatly reduced one of the most hazardous tasks formerly confronting the station operator or gauger. Simply by the use of a panel in the station and appropriate electrical or electronic circuits to the tanks on the farm, the exact height of the contents within any tank can be determined from indoors, regardless of the weather. This remote gauging device, with automatic temperature recorders within the tanks or in the suction stream, enables an exact check on flow to be maintained without climbing tanks and the use of hand lines and tank thiefs.

Where the use of meters is legalized for the transfer of fluids, either from lease tank to pipe line or from the pipe line terminal to the customer, elimination of the hand-gauging operation has permitted a reduction in the number of men needed to operate a given line, and has greatly reduced the physical demands made on such men as are in attendance. On products lines, the use of meter provers is now standard practice, and meters are a prominent part in the equipment of the terminals. For intercompany transfer they have largely supplanted the hand-tape tank gauge and thief.

It is a far cry from the days when men of the maintenance gang were strung out at four-mile or longer intervals along the right-of-way to listen for and try to detect the passage of a "pig" or pipeline scraper. And, once picking up the sound which betrayed the subterranean traveler, to attempt to follow it on its cross-country travel, or to mark the spot at which the sound ceased so that the line might be dug up and cut for removal of the obstruction. The scraper now is a modern pipe line tool, designed to meet line conditions, and equipped to travel, unchaperoned, for the distance between stations or scraper-traps. Various devices for indicating the location of the scraper, if stuck, include the positioning of a small slug of Cobalt 60 or some other radioactive substance in the nose of the instrument so that passage of the pig can be indicated with a Geiger counter, or its point of arrest accurately spotted by traversing the line with such a unit.

Scraper runs are now scheduled as a regular operating procedure; predicated on such factors as line throughput drop, pressure rise when checked against previous similar runs, presence of water at drips or in low spots of the line, or when it is desired to run scrapers as sealing devices between slugs of widely varying liquids. Neoprene and other oil-resistant elastomers in driving disc fabrication, spring mountings which automatically take up brush wear, articulated shanks or gang-type scrapers for traversing sharply curved sections: all these factors add to the effectiveness of the "pig" as a pipe line maintenance tool.

The art of plugging a line against pressure, to replace the former methods of blocking off a line or draining the section back to a gate or point of gravity break, enables line repairs or changes to be made in a fraction of the time formerly demanded, and allows the pipe line to remain full of fluid up to the point of repair, and thus to resume full volume pumping as soon as the line is put back into service. The plugging device, entering the line through a side opening which can be completed without shut down or pressure drop, is so designed that the greater the pressure against the expanding lip of the plug, the tighter the seal. A line thus sealed off is fire- and explosion-proof, and work at the repair site can be carried on without expensive and time-consuming handling of lage quantities of vented fluid.

Tapping a line under pressure, or "hot-tapping," is now a standard method of making a tie-in with a line in service. The process requires the welding of a saddle, either partial or line-encircling, at the point of entry. A valve is bolted to the flange serving as upper end of the pipe stub set into the saddle, opened, and the tapping machine bolted to the upper flange of the valve. A hole of the desired size is then drilled through the pipe wall, an ingenious keeper on the bit retaining the coupon cut from the pipe so that it is retracted with the bit. The device will cut any hole up to the pipe diameter, depending on the size of the saddle used. After the tap is complete the drilling unit is withdrawn through the valve, the valve closed, and connection made to the top flange of the valve after the tapping device is removed. This machine has been successfully used on a submarine line, working within a specially designed split caisson of steel at a depth of more than 20 feet below the surface of the Gulf of Mexico.

Dispatching a trunk line, whether handling various grades of crude oil, or the multiplicity of fluids daily tendered to a products line, has progressed from the relatively simple matter of emptying and filling sets of tanks at intervals contingent on their availability at the suction and need at the discharge ends of the line. The dispatcher now is in charge of a line in which the throughput moves steadily forward; his the task of regulating the input, pressures, withdrawals and number of pumps on the

line to achieve maximum delivery and yet stay within the design limits of the equipment under his control. On one products line, for instance, so slight a change as the increase of only eight barrels per hour in the amount withdrawn at one of the intervening terminals or delivery points on the line compensated for the pressure change developing as the advancing front of a new tender moved into the system.

Today's dispatcher would be swamped by the demands made on him were he compelled to use earlier methods of communication, computation and line control. He must possess a wide and instantly available fund of knowledge of the physical characteristics of his line. He must know where upgrades and slopes exist, must have a clear picture of all topographic conditions so that, if he were operating a products line and faced need of a shut-down, he would be able to avoid halting the interface between such products as kerosine and house-brand gasoline on a slope—and thus avoid gravity commingling and loss of quality.

The keeping of dispatching records is now standardized, and is far from the sketchy memoranda of tank gauges, temperature readings and BS&W shake-outs which used to be the basis for all delivery calculations. Accurately scaled run tables and tapes, with each unit of the scale or tape representing a fixed length of line holding an equally exact volume of fluid per unit of pipe length, permits graphic representation of interface relationships. Calculating machines, special slide rules, and various specialized types of business machines make the computation of runs a matter of pushing a few buttons, manipulating a computer manual, or feeding a few punched cards into a machine; instead of the laborious long-hand calculations involving tank tables, temperature corrections and gravity constants which afforded so many chances of error that it was a minor miracle when somewhere in a day's records "boilerhousing" of a few figures was not needed to make the day's work balance.

Automatic operation of pipelines has not only grown with, but has been largely responsible for, the growth of today's big pipe line. From the full manual control of 25 years ago, when the station engineer had to be thoroughly grounded in a sequence of operations in order to put his station or a unit on the line, to the push-button starting of today represents an advance in pipe line technique greater than any developed in the entire previous history of the art.

With modern electronic controls a unit or an entire station can be put on or taken off the line by means of a series of not more than three push-buttons, and in many instances by a single button. Electronically actuated units provide the proper sequence of valve openings, pressure build-up, and running conditions. A second set of electronic units, coupled with the first, not only indicate the proper functioning of the starting sequence, but also locate the site of any malfunction which may interfere with proper operation. The same system, once the start-up is accomplished, enables the dispatcher at his post many miles distant from the station to push a scanning button and have reviewed for him a summary of conditions in the designated station. On some lines he can push a small button at his elbow and through strategically placed microphones listen to the hum of a motor or the purr of an engine out on the line hundreds of miles from his office.

A score of years ago mention of the word "satellite" to a pipe liner conveyed no meaning unless the man chanced to be an amateur astronomer. Today every pipe liner knows a "satellite" is a station which is remotely controlled from another station or from the dispatcher's office, and that it is normally unattended. One line has such a station, properly spaced on the line's hydraulic gradient, located about 90 miles from the control point. The power in this station is a multi-cylinder internal combustion engine, connected to a multi-stage centrifugal pump. The unit is started, checked, and put on the line in this satellite station from the head-of-line dispatcher's office, and serves as a booster when throughput conditions warrant. All this is without a man in attendance or even observing, except when his regular tour of inspection brings someone to the station.

Such remotely controlled stations are frequently met on pipe lines where purchased electric power is available. The electric motor is essentially a remote-controlled device, and whether the panel be located a few feet or many miles from the motor need make no difference in its performance. All required in addition to regular starting equipment is a scanning system to insure against damage in case of malfunction. These electric stations are of the compact, unitized type in which motor, pump and valves are housed in one building. Closed ventilation systems for the motors and a plenum system of ventilation insure the station against hazard through leakage at the pump and, as mentioned before, development of pump seals has reached such a high standard that leakage and/or failure may be discounted in planning long runs.

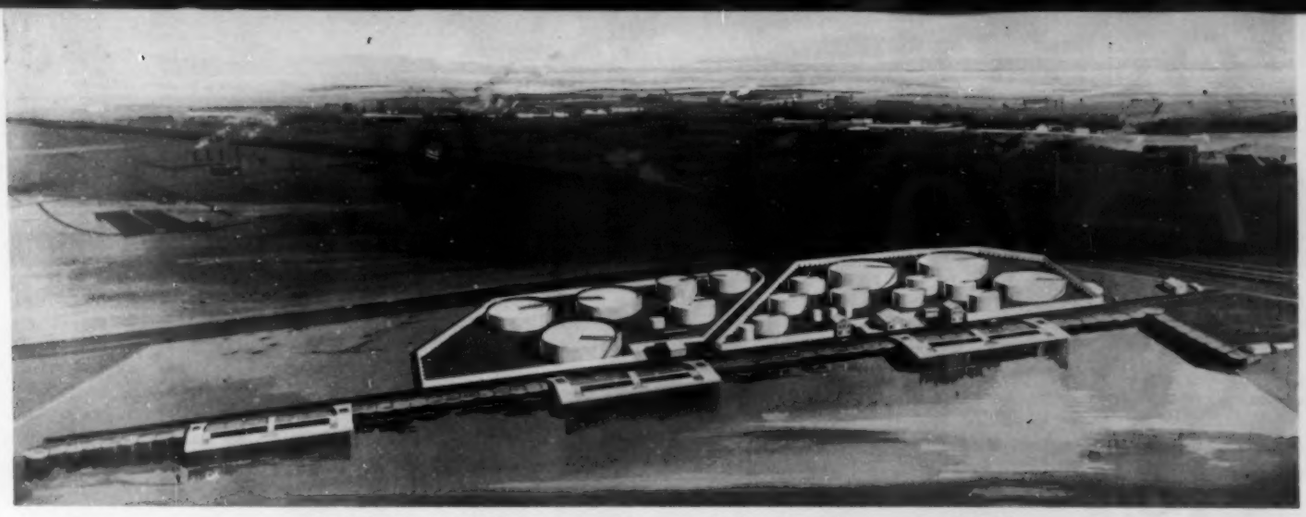
Perfection of open-air motors and controls, completely weatherproof, with at the most a small enclosed panel for the automation units, enables some modern pipe lines to dispense with the pump house. This is not only a big saving in initial station expense, but also a major factor in explosion and fire prevention. Having no pocket or enclosure to trap and hold escaping gases or fumes, any present are dissipated by wind currents and explosive mixtures thus prevented. With outdoor equipment, the only station structure needed is that for the control panels, with a small office for the supervisor's occasional visits.

Development of pipe line microwave systems and other methods of communication which enable a large number of messages to be carried simultaneously over a single carrier has kept pace with the progress in automatic controls so that the microwave channels offer the pipe line engineer a means of directing and implementing operations far beyond manual reach. The improved means of communication has made it possible to funnel into one central office all the detailed operation data

(*Continued on page 63*)

A modern aid to better pipe lining. This unit is sent through a river crossing and records the exact location of the underwater line as a check against possible erosion by the stream or shift line.

Panel in microwave system enabling the supervisor to check the operation at any point down the line. This is part of the equipment in a dispatcher's office.

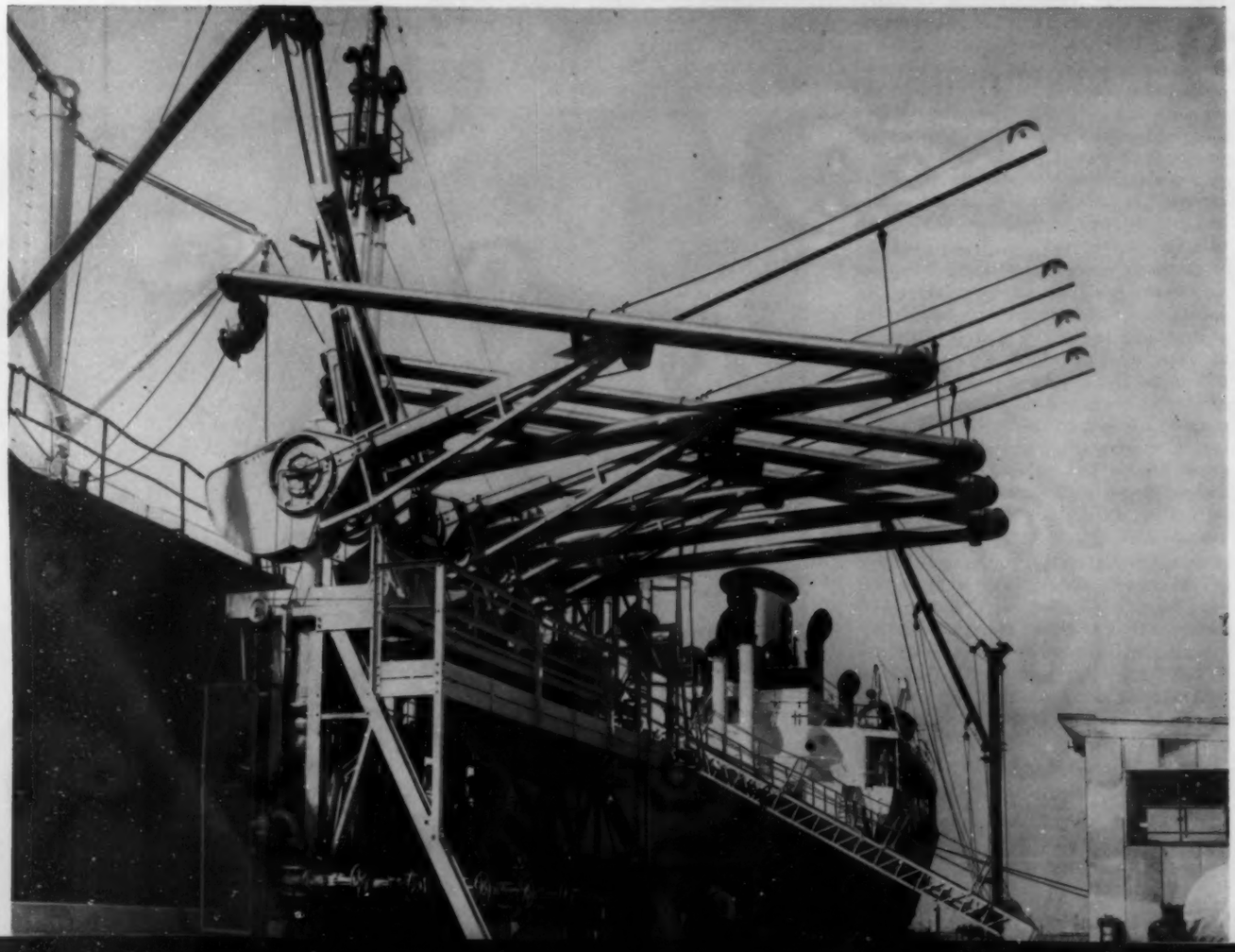


Artist's sketch of Richfield Oil Corporation's new $5 million Long Beach marine terminal.

Rubber hose has been replaced by all-metal loading lines at new Long Beach, California, marine terminal. Lines are mechanized for speed and manpower saving.

Mechanized Loading Lines Feature NEW RICHFIELD TERMINAL

Hydraulic power operated assembly designed to mechanize and speed tanker loading.



CONCURRENT with the post-war step-up in tanker capacity and speed has been the effort of oil companies to reduce port time as a means of effecting shipping economics. Docking facilities are being rebuilt to speed cargo loading and unloading through faster connection of loading lines and greater pumping capacity.

Richfield Oil Corp. of Calif. is currently spending $5 million to modernize its No. 2 marine terminal at Long Beach, Calif. The company owns 1,000 feet of frontage and is leasing another 1,400 feet from the city of Long Beach.

Storage facilities are being increased to accommodate an additional 500,000 barrels of crude and products. Tanker ballast facilities are being enlarged and supplemented with new separators and larger pumps. The entire storage area is completely encircled by a 30-foot cellular concrete bulkhead.

Three concrete docks are being built, each suitable as a loading or unloading berth for a modern tanker. The terminal will be able to berth one T_2 and two supertankers simultaneously. The entire dock area is being built up to compensate for the general subsidence of the shore area which is said to be the result of the very great withdrawal of oil from Long Beach fields. To speed loading and unloading Richfield has installed a newly-developed Chiksan loading-arm assembly employing power operated metal tubes and swivel joints to replace the traditional rubber loading hose. The loading arms employ some of the same elements Chiksan has employed for many years in bulk plant and tank car loading racks and for drilling fluid handling on rotary rigs. First of the three Chiksan installations has been put into service and the remaining two will be installed before the end of the year. Each will consist of five 8-inch loading lines.

Mounted on a structural steel frame located near the water's edge, each of the five marine loading arms at the Richfield terminal consists basically of two lengths of aluminum pipe. These are coupled together by Chiksan aluminum swivel joints. A boom and cam arrangement, powered by hydraulics, enables one man stationed in the control tower to place the flanged end of the arm aboard the largest existing tanker in less than a minute without any preliminary operations. Once aboard ship, a two-man crew can easily make up the flange to the deck manifold. When attached, the power system on the arm is placed in free wheeling. This allows for a 40-foot rise and fall of the ship in the water, and permits a 20-foot or more drift of the vessel during loading or unloading operations. In free wheeling, operations may proceed unattended. When detached, the arm can be returned to a rest position in less than a minute.

Each of the five arms may be operated from one set of controls. The arm to be attached is selected by means of a selector valve with selector dial located at control point. One 7.5 gpm, 500 psi vane type pump and one 3 hp motor power the movement of each of the arms in turn.

The arm is grounded for static and is spark resistant. The unit is operational at temperatures as low as 60°F. and to 225° F. without deterioration or lessening of ease of operation.

In cooperation with the Aluminum Co. of America, Chiksan has perfected a method of casting a steel collar as an integral part of the aluminum casting of the swivel joint. This enables the ball races to be cut into steel and flame hardened, thus providing for maximum wear and flexibility in joint rotation. At no time does the fluid passing through the loading arm come into contact with this steel insert.

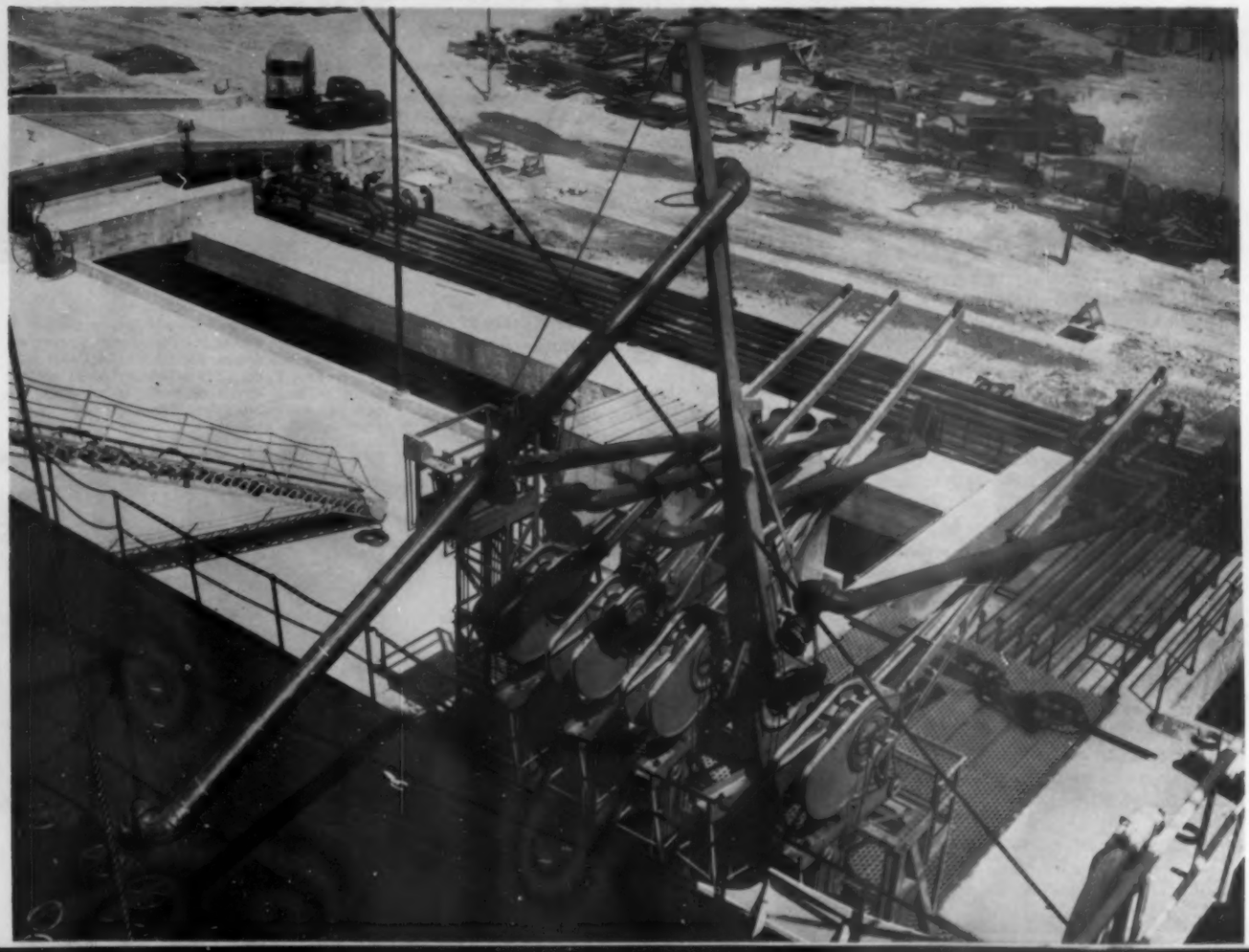
Benefits expected with the new arm include reduced fire insurance and workmen's compensation insurance premiums. Because there is no tangle of hose to manhandle, back injuries are expected to be virtually eliminated.

The all-metal arm will resist bursting and thus eliminate accidents involving costly clean-ups, and considerable lost time. Hose bursts have cost upwards of $40,000. By virtue of its all-metal construction, the Chiksan loading arm is expected to outlast many times the life of the rubber hose. The aluminum arms are rated for operating pressures up to 300 psi with a safety factor of eight to one. Hose safety factor is four to one.

A 5-arm unit such as Richfield has installed occupies an area of 10 by 24 feet and the arms ride 15 feet above the dock, making possible easy access to the ship's side for emergency vehicles.

(Continued on page 85)

View from tanker deck showing aluminum loading line flanged to ship lines.



Ray Bradley, left, and O. M. Griffin run an odor test of the heavy oil that has accumulated in the 100-year-old mine near McKittrick in California's Kern County. Mr. Bradley is lease foreman for Sunray Mid-Continent Oil Co. and Mr. Griffin is district superintendent.

California Oil Mine Rediscovered

By Quinton Peters

ONE of the country's most primitive oil-producing operations, an oil "mine," has been rediscovered in California's colorful San Joaquin Valley. The mine is actually producing oil today . . . just a trickle to be sure, but enough to qualify for "production."

The mine is believed to be nearly 100 years old. Located 100 yards west of Highway 33, about one mile south of McKittrick in Kern County, it is near Sunray Mid-Continent Oil Co.'s McKittrick Fee and McKittrick government leases.

Lease Foreman Ray Bradley and an adventurous crew of Sunray Mid-Continent production men in his area "rediscovered" the old mine recently while prowling through the area in search of a brea pit. The brea pits, according to nearby Kern County Historical Society markers, were pits of asphaltum seepage in which hundreds of birds and animals were trapped during the Pleistocene Age, some 15,000 to 50,000 years ago.

The brea pits are there all right, and so is the old oil mine. And Bradley's research indicates there was at one time a connection between the two. According to existing written material on the subject, along with comments from oldtimers and bits of native legend, the thick oil or asphaltum from the old mine was hauled to the areas of the brea pits. There the oil was heated in crude stills over fire made from the oil-soaked bones of the animals that were trapped in the pits.

The product sought was kerosine. This kerosine was hauled by mule train over to the Pacific Coast and then probably shipped north to the market in San Francisco. Some oldtimers in the San Joaquin Valley can recall working the mule trains that worked the brea pits, or working at the old crude stills.

The entrance of the old mine resembles a small-scale version of an old type coal mine. The boarded entrance is about 3 feet square. The mine extends about 30 feet back into the side of a buff-colored hillside. A casual passerby will not happen upon the mine; he has to explore to find it. There is no marker of any sort. The mine itself is hidden from view on the steep side of a hill that overlooks a gulch littered with sagebrush, old bull-wheels and rusty pumping jacks, all remnants of a by-gone oil era.

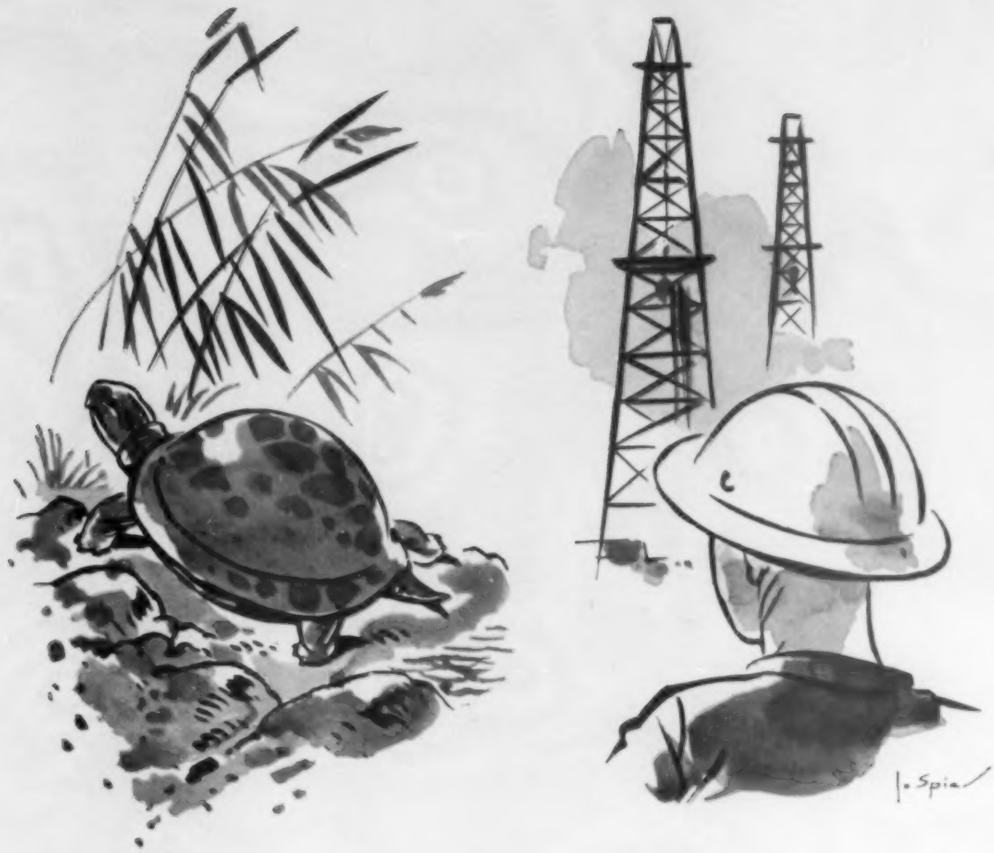
The mine apparently was dug in the early 1860's, not long after the gold rush. Digging tools were certain to have been primitive, probably hand picks. Timbers to support the mine were sturdy 6 by 6 footers, rough hewn and probably dragged in from the nearby Temblor range of mountains.

Just inside the mine's entrance, a pit about five or six feet deep was dug to permit accumulation of the asphaltum which seeped from the veins of the hillside into the mine. An oil "miner" could easily scoop up wooden buckets full of asphaltum from this pit, carry it down the gulch to waiting wooden barrels and then transport the barrels by mule sled to the nearby brea pits.

Of course, much of this explanation of the early-day oil producing operation is speculative. But the mine does exist; and it does produce heavy, thick oil; and the brea pits are nearby. And San Francisco really did burn kerosine in the 1860's. It is certainly within the realm of probability that the old mine helped light some of the lamps of early-day San Francisco. END

A tiny stream of oil still oozes down the hillside from the old oil mine. Here Sunray Mid-Continent production men inspect the heavy, thick asphaltum.

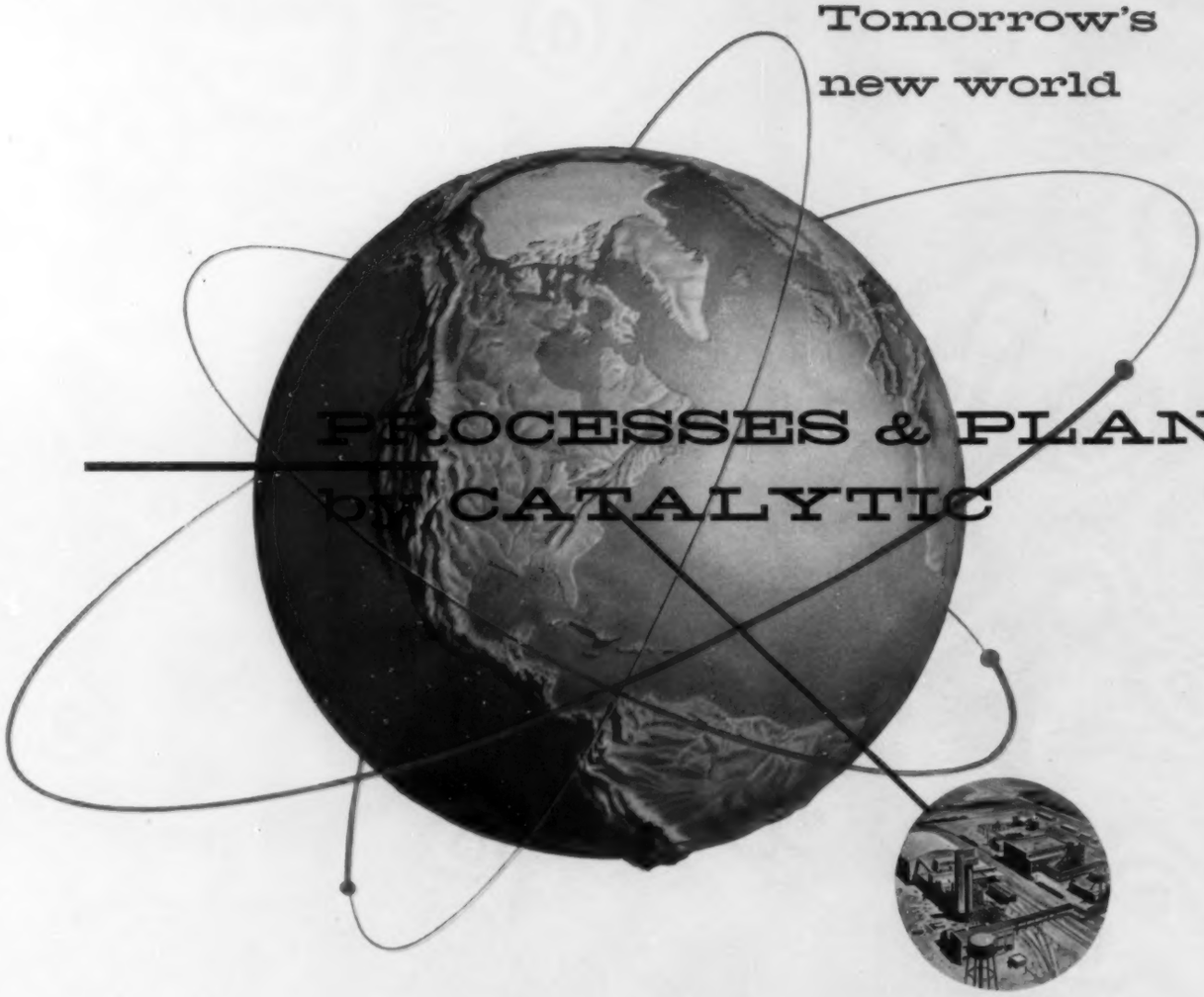
Bones of birds and animals which were trapped in asphaltum seeps during the Pleistocene Age are exposed on a hillside near the oil mine in California's San Joaquin Valley. The oil-soaked bones are believed to have served as fuel for operating the early-day crude stills which processed the mine's heavy oil into kerosine.



PROTECTION

SCHLUMBERGER
THE OIL MAN'S
PROTECTION

Toward
Tomorrow's
new world



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Modern Pipe Line Operation

(*Continued from page 57*)

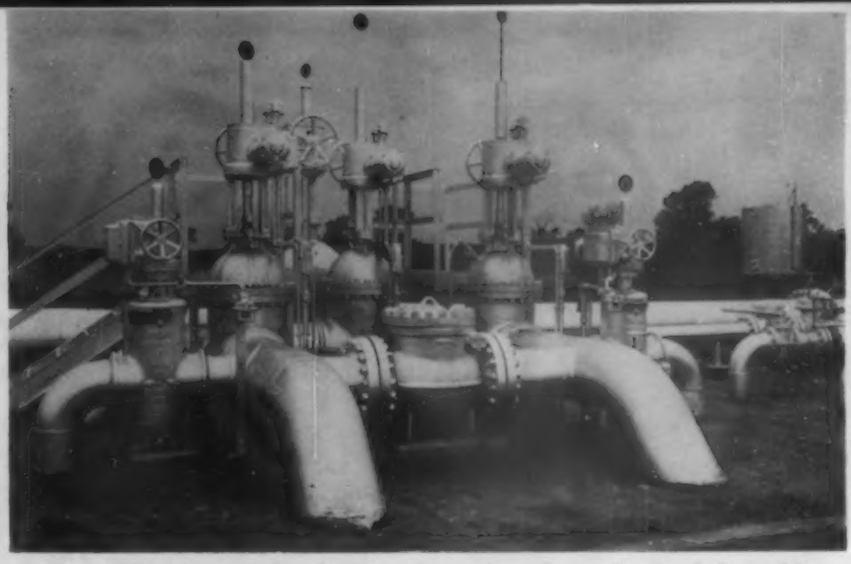
from each of a number of stations and, through electronic machines, to sort out and interpret these items of data in such a manner as to predict their influence on pipe line throughput. Then, through this prediction, to plan the necessary functioning of the automatically controlled equipment to produce the desired optimum line operation.

Aerial surveying, a valuable tool in the laying out of a modern pipe line, also serves the industry well when designing a microwave system to become a part of the pipe line—to become, as it were, its nerve system. With aerial surveys it is possible not only to lay out the pipe line most advantageously, but to determine the sites for microwave towers so that their spans will be most effective and will bypass or avoid areas where interference might develop. With an adequately planned and equipped microwave system the present-day pipe line, even though still manually controlled by station crews, has at hand the backbone to support the network of communications requisite for the transmitting and receiving of the multiple impulses needful to start, stop, and check a completely automatic pipe line station.

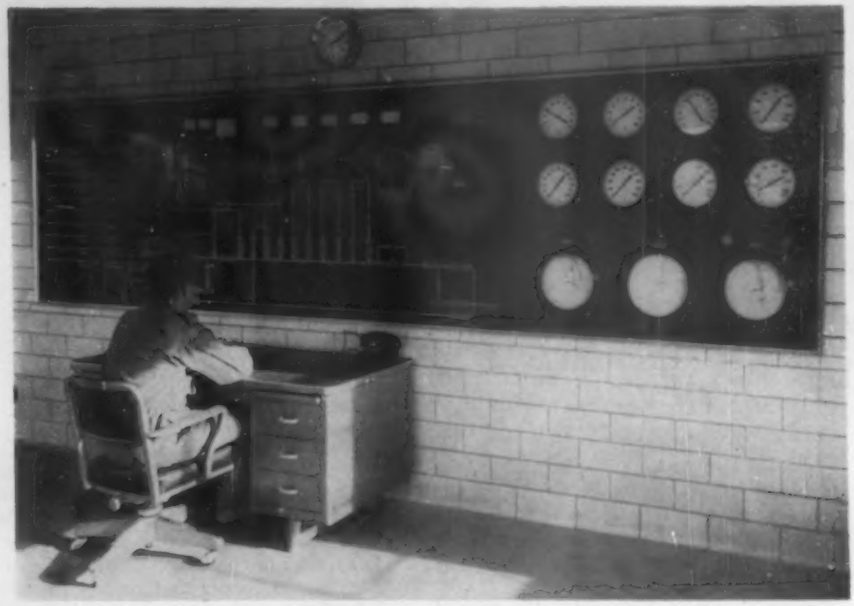
Progress in corrosion mitigation, with a better understanding of the underlying causes of pipe line corrosion, has led to the development of protective systems in which the prospective life of a line can be closely calculated. From this it is possible to arrive at the amount of corrosion protection which is economically desirable, and to provide the necessary safeguards against premature pipe failure. Through the use of cathodic protection with rectifiers or sacrificial anodes, combined with adequate initial protection of the pipe with engineered coating and wrapping programs, it is possible to insure a line against corrosion over a long period. So long, in fact, that many pipe lines have served their original purpose, have been reclaimed and reconditioned, and are now operating under conditions as severe as those when the steel was first put into service.

Continued progress in the use of inhibitors to protect against internal corrosion, especially in products pipe lines, has made for better handling of throughput with delivery in condition comparable to that when it was introduced into the line. Use of inhibitors, besides maintaining product purity, also prevents or greatly reduces internal corrosion, and thus extends the useful life of the pipe. Pipe line maintenance crews, at first skeptical of the value of corrosion control measures and hostile toward corrosion engineers, now consider themselves a part of the corrosion prevention force and assist in the work of installing and maintaining the rectifier, anode and ground-bed systems.

The line walker of two decades ago has taken wings. Supervision over the right-of-way, formerly laboriously covered afoot in sections of from 20 to 40 miles per man-day, now is handled far more effectively by one man and a small airplane. The pilot not only inspects the immediate area of the right-of-way, but also, from his elevated observation post, is far better equipped to detect possible disturbance of the line by line-tapping operations, highway or other public utility construction, incipient erosion by streams and all other factors which might cause damage, a line break, or injure the landowner through whose property the right-of-way extends.



Cluster of big valves required to place intermediate station on line or allow it to be bypassed by stream from up the line. Discs afford distance indication of valve condition.



Panel above supervisor's desk in pipe line station, with diagrammatic representation of valves and units and with lights to indicate "on" or "off" positions.

Beginning with the right-of-way or land man who must obtain the clearance without which a line cannot traverse a given piece of land, and carrying on through the contractor who lays the line, the question of public relations today evokes an answer far different from that in the earlier days of pipe lining. The pipe line company regards itself, and wishes to be regarded by the natives, as one of the neighborhood. Recent pipe line dedications, instead of being planned for the top brass of the celebrating and other pipe lines, now are promoted for the benefit of the landowners through whose properties the line passes. Some of the recently completed trunk lines have expanded the idea of dedications by holding a series of celebrations, scheduling them in sequence from end to end of the line so that at each station landowners up to midway points in both directions can be invited, can meet the company official family, and especially can meet the men and families of the men of the pipe line who are coming into the community or area to operate that particular section of the system.

Through such gatherings the pipe line company not only establishes itself as another "citizen" with the native landowners, but also in many instances is able to enlist abutting property holders as friends —friends who take the pipe line's interests to heart and who willingly co-operate by advising of stock or other trespass, incipient damage and other factors which, if left unheeded, could easily develop into court cases. END

This the first of a series of three articles by Prof. Uren in which he will summarize late developments in reservoir technology. The second will appear in an early issue.

Diamond drill, soxhlet extractor and diamond-set saw for preparation of core samples, University of California petroleum laboratory.

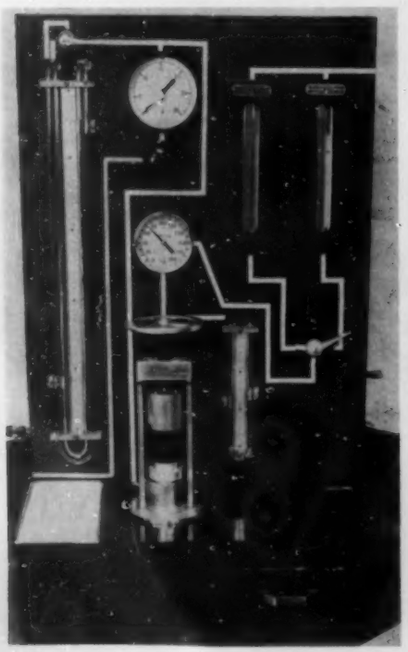
Part I

Progress in RESERVOIR TECHNOLOGY

By Lester C. Uren
Emeritus Professor of Petroleum Engineering, University of California

FROM time to time it is helpful to take stock of progress achieved in an expanding field of scientific development, to chart the trends, and perhaps forecast future results. The writer has closely observed the development of oil and gas reservoir technology over the past four decades and here seeks to record the principal achievements during this period and to appraise the present state of our knowledge of the factors that control reservoir behavior.

Commercial type of permeameter, University of California petroleum laboratory.



Unfortunately, many of the important contributions to the literature of reservoir technology are reported in highly technical phraseology, with frequent use of advanced mathematics that many people who are interested in this subject are unable to understand. The writer plans to present his review primarily in physical terms with minimum use of mathematics, in a style that all readers of WORLD PETROLEUM may readily understand.

The material will be presented in a series of three articles, beginning with the present one which will be concerned primarily with the nature of oil and gas reservoirs. The second article, which will appear in an early issue of WORLD PETROLEUM, will deal with the nature of reservoir fluids, and the third and concluding article will discuss the factors that control drainage of fluids from reservoir rocks. A selected bibliography will accompany each article, designed to assist the reader in the event that he may wish to explore the primary literature to which frequent references will be made.

Historical Development of Reservoir Technology. Pioneer oil producers had little understanding of the complexity of the mechanism with which they had to deal in draining oil and gas from underground reservoirs. Experience taught that they had merely to drill a well through an oil-bearing formation and nature's forces would bring oil and gas into the well and, in some cases, to the earth's surface. While it was generally understood that oil and gas were stored in and had to flow into the wells through the minute pore spaces of the reservoir rocks, practical knowledge of the size and character of the pore spaces, the percentage porosity and oil saturation as a measure of the oil-storage capacity of the reservoir, had to await development of dependable methods of formation sampling. It was not until about 1920, when the first dependable coring tools were developed, that fairly representative samples of the reservoir rocks were made available for technologic studies.

Attention was first directed toward studies of the physical character of reservoir rocks and the lithologic properties that influence storage capacity for fluids and flow of fluids through the pore spaces. During the decade 1920 to 1930, the first scientific studies of reservoir rock porosity and permeability were made. During these early years, and particularly during the subsequent decade 1930 to 1940, interest also attached to the character of the fluids present in the pore spaces under the conditions presented in nature's oil and gas

reservoirs. Instruments and methods were devised for measuring depth pressures and temperatures in wells and for obtaining samples of reservoir fluids.

Comparisons of oil recoveries obtained in field operations with calculations of reservoir storage capacity for fluids and observed oil saturation, indicated that the methods of field exploitation employed during the earlier years were inefficient; that the wells actually produced but a small percentage of the oil present in oil-field reservoirs. Percentage recovery of the order of 10 to 30 per cent was indicated for ordinary methods of flowing and pumping. This knowledge focused attention on possible improvements in production methods whereby a larger percentage of the total oil content of the reservoir might be secured; and it was recognized that the first requisite of an improved method of oil recovery would be a better understanding of conditions existing within reservoir rocks and of the forces that bring about movements of fluids through the pore spaces.

During earlier years, petroleum technologists based their concepts of reservoir behavior largely on field observations, but eventually it became apparent that laboratory research might contribute information of value in the search for methods that would result in improved recovery efficiency. During the decade 1920-1930, many research projects were initiated, designed to explore and evaluate the physical variables that control drainage of petroleum from its reservoir rocks. Technologists in the employ of some of the more progressive oil companies, the U.S. Bureau of Mines and several universities participated in these early investigations. For the most part, these were only reconnaissance studies, but they served to indicate the relative importance of the different factors involved and to "set the stage" for more intensive studies during later years. In 1928, the American Petroleum Institute began to sponsor a fundamental research program and some of the early A.P.I. projects were designed to explore the phase relationships of hydrocarbons and the basic conditions governing flow of fluids through porous media. It is interesting to note that many of the objectives of these early research programs are still under intensive study today, though more elaborate and precise equipment is now available and dependable quantitative measurements are obtained, whereas most of the early investigators were necessarily content with qualitative results. Gradually, as oil company officials became convinced of the importance and value of research, these activities were expanded until today, nearly every major oil company supports a production research organization. Laboratory facilities costing many millions of dollars have been assembled for this purpose and, in the aggregate, many thousands of research workers are now employed.

As the results of these research programs accumulated, petroleum engineers began to seek an analytical approach to the mechanisms by which fluids are moved through and from the reservoir rocks into recovery wells. It was recognized that at least three fundamentally different natural forces are operative in expelling oil and gas from the reservoir rocks and that these expulsive forces are opposed by several retentive forces. It became apparent that recovery of petroleum from its reservoir rocks is influenced to an important degree by these natural forces and that the percentage recovery achieved is dependent upon the efficiency with which they are utilized and controlled.

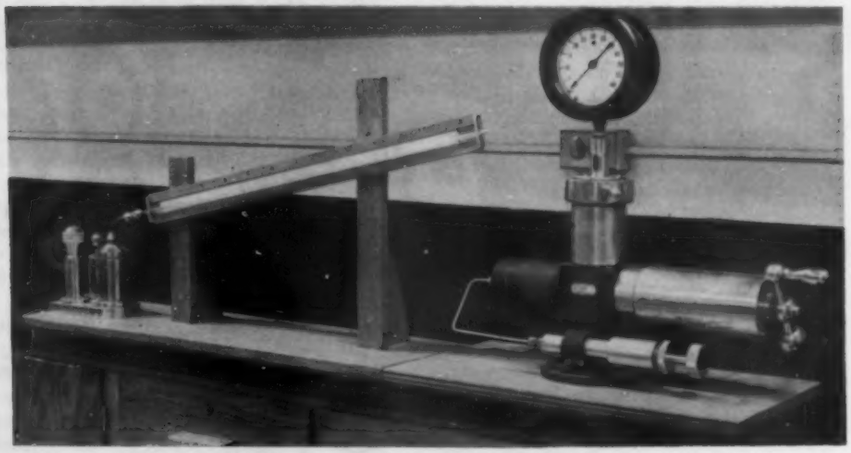
From the foregoing brief review of the development of reservoir technology, it is apparent that practically all of our present-day information on reservoir conditions has been accumulated during the past three decades. During this relatively brief period, an entirely new and unique field of engineering science has been unfolding. Important progress has been made in the quest for more complete understanding of the conditions existing within petroleum reservoirs and of the factors controlling drainage of oil and gas from these reservoirs. But we must not assume that we have reached a complete understanding of this important phase of petroleum technology. Each year new information is accumulated in the literature to add to our store of knowledge upon which we can draw in solving reservoir problems. The continuing efforts of our scientists and engineers will doubtless, during future years, add to our understanding of oil and gas reservoirs.

Boyles' Law type of porosimeter, University of California petroleum laboratory.

Indeed, "reservoir engineering" has become one of the major fields of specialization in the realm of petroleum engineering. Many engineers now give their whole time to this specialization. To permit of application of this specialized knowledge in improving production methods, oil producers now spend large sums in formation logging, sampling and testing and in collecting reservoir data. There is need in the oil-producing industry for more engineers trained in the specialized techniques of reservoir engineering, and this field offers unusual rewards for men who are able to apply intelligently its principles in the control of oil-producing operations.

Definition of an Oil and Gas Reservoir. An oil and gas reservoir may be defined as a continuous body of porous and permeable earth formation in the pore spaces of which oil and gas are stored and through which they may flow toward outlets under pressure differentials developed by natural forces or which may artificially be applied. Porosity is essential to provide storage capacity; permeability, resulting from continuity of pore spaces, is essential to permit

Mercury volumeter and Kobe porosimeter, University of California petroleum laboratory.

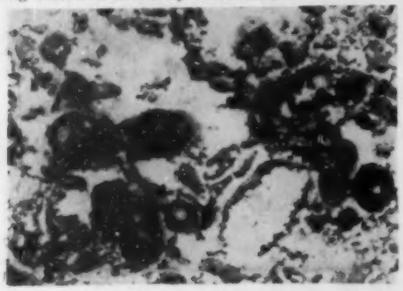


flow of fluids through and from the reservoir rock. Because of the frictional resistance to flow through the constricted pore spaces, a considerable pressure differential is necessary between different parts of the reservoir to bring about movement of the fluids.

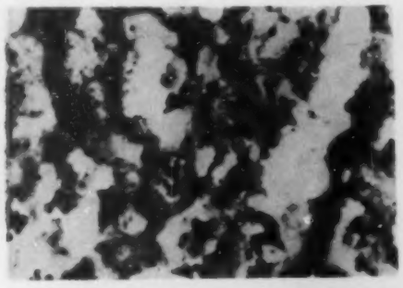
The form and lateral expanse of a reservoir is determined by the character of the geologic structure responsible for the oil and gas accumulation.[7] Broad anticlinal and dome structures with low-dipping flanks may form reservoirs embracing many thousands of acres in lateral expanse. The "closure" of such structures may afford hundreds of feet of vertical distance between the structural crest and the edge-water line. On the other hand, faulted structures, salt dome deposits and stratigraphic traps usually form reservoirs of relatively small lateral expanse.[11]

The storage capacity of a reservoir is influenced by its thickness as well as by its porosity and lateral expanse. A reservoir usually comprises several, perhaps many rock strata and may vary from a few feet to many hundreds of feet in thickness. In some cases, the oil and gas are confined to a single well-defined reservoir of fairly uniform thickness, but in some regions two or more—perhaps many—separate reservoirs, one above another, separated by impermeable, perhaps water-saturated strata, from producing "zones" of great overall thickness.

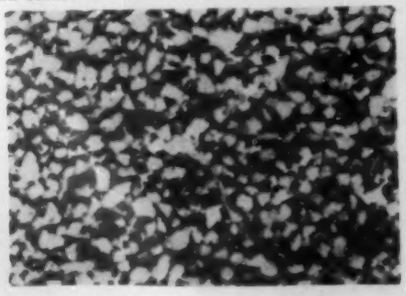
Microphotograph of limestone reservoir rock showing extensive secondary cementation.



Microphotograph of a highly permeable limestone reservoir rock.



Microphotograph of highly porous and permeable oil sand.



Reservoir Rocks. Rocks which provide adequate porosity and permeability to serve as oil and gas reservoirs include granular sedimentaries ranging from unconsolidated sands through semi-consolidated to well-cemented sandstones, and limestones of various types. Shales, clays and fine-grained "siltstones" may possess adequate porosity and may actually be saturated with oil, yet may not be good reservoir rocks because of their low permeability. Oil may not flow freely through and from them into recovery wells.[10]

Sands and Sandstones. Reservoir rocks are always sedimentary rocks, formed under water by natural processes of sedimentation. They are nearly always marine sediments, laid down along sea coasts or on the continental shelves or in river estuaries, and their pore spaces are left filled with salty sea water which is later displaced or partially displaced by migrating oil and gas. Nature's processes of sedimentation result in gradual settling and adjustment of the granular rock particles in such fashion that their larger dimensions are oriented in a common direction, overlapping to some extent, resulting in a certain degree of horizontal stratification of the resulting rock stratum. Wave action sometimes disturbs the normal stratification, resulting in "cross-bedding," which is characterized by inclination of the stratification from its normal horizontal condition.

Usually, the coarser sand fragments are deposited near shore lines, finer sand grains farther from shore, while clay particles and other very fine material will be carried still farther out on the continental shelves before settling and consolidation may occur. However, seasonal changes in the flow of rivers and wave action incidental to heavy storms, may disturb this normal distribution of sediments. Thus, it is common to find a stratum of coarse sand overlain by a stratum of fine sand or clay, with alternations of fine-grained and coarse-grained strata marking different seasons of accumulation. Classification of the coarse and fine grained materials may be fairly complete, forming clean beds of sand grains of fairly uniform size; but more commonly the segregation of fine- and coarse-grained material is not complete and fine-grained material will be found deposited among the coarser rock fragments.

Sand grains are degradation products resulting from weathering and disintegration of igneous, metamorphic and earlier sedimenary rock masses. They usually are crystalline fragments of the more common rock-forming minerals, such as quartz, calcite, hornblende, augite, feldspar, etc., with occasional grains of the less common minerals. The form of individual grains will be determined somewhat by the crystalline character of the mineral of which it is composed, modified by abrasion suffered during river transport and by rolling on beaches. Sand grains may be broadly classified as "rounded," "subangular" and "angular." They thus appear in an infinite variety of shapes and sizes and are of variable mineral composition. The mineral composition, however, has little significance in determining reservoir characteristics, except in so far as it may influence the crystalline form of the sand grains.

Because of their crystalline properties, mineral grains may present a variety of different surfaces to the fluids stored in their pore spaces. Some minerals, like quartz, are likely to be smooth-surfaced and "glassy." Others, like the feldspars and calcite, are usually angular; hornblende and augite are angular with rough edges; others, like the micas, are "platy." Subsequent deposition of secondary minerals on the surfaces of the primary crystalline grains may leave the surfaces roughened or "drusy." Secondary minerals are formed by precipitation from aquaeous solutions or may result from chemical alteration of the primary minerals as a result of oxidation and weathering. Common secondary minerals include silica, calcium carbonate in its different forms, iron oxide, various types of clays, etc. They are usually deposited slowly, over a long period of time, by migratory ground waters, on the surfaces of sand grains and in reëntrant angles and crevices between grains, and may form a resistant cementing material that binds the individual grains firmly together. The original porosity and permeability of the sand may be greatly reduced by deposition of secondary minerals.

Sedimentary formations are deposited, layer upon layer, often with slow regional changes in elevation that permit accumulation of great thicknesses of sediments. In some cases, continuous bodies of sedimentary formations are many thousands of feet thick. As they grow in thickness, the accumulating weight of the overlying strata exerts a compressive effect on the deeply-buried strata. The "earth pressure" so developed is roughly one pound per square inch per foot of depth, so that very high pressures may develop in formations several thousand feet thick.[7] Compression of sedimentary strata results in compaction of grains and reduction of pore space and is particularly effective in fine-grained argillaceous rocks, less so in coarse sands and sandstones. When clays first accumulate on the ocean floor, they may have porosities in excess of 90 per cent, but later consolidation and compaction may reduce their volume to but a small percentage of that originally occupied, with reduction of pore space to but a few per cent of the bulk volume of the rock.

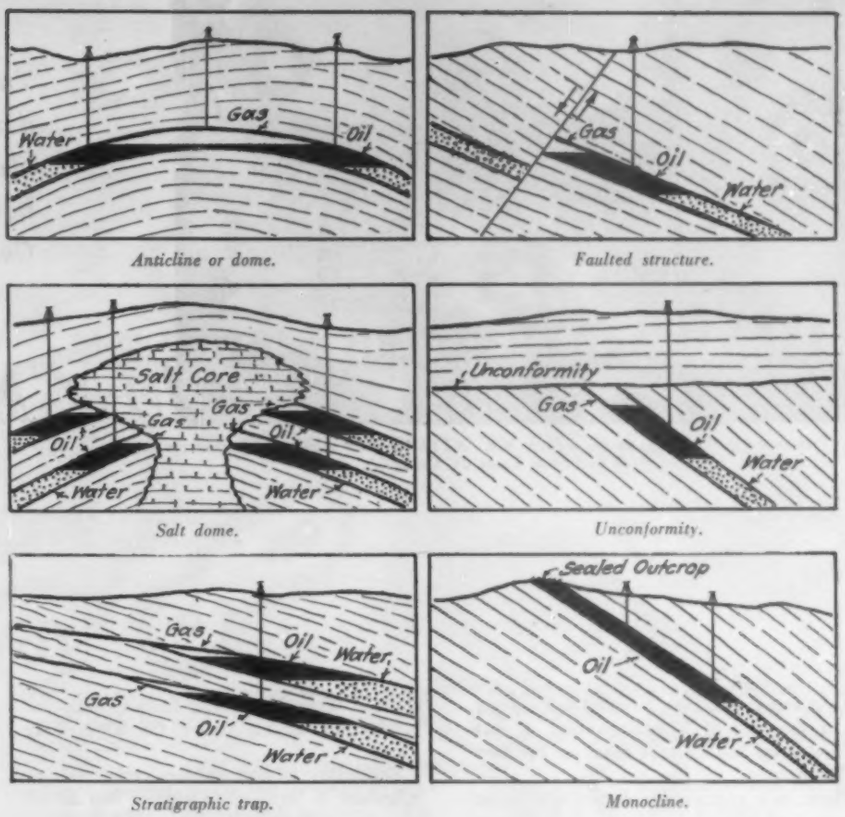
Calcareous Reservoir Rocks. Limestone and dolomite are reservoir rocks in many of the world's most prolific oil fields. Such rocks are formed under shallow water conditions along ocean shore lines by accumulations of mineralized remnants of

former marine plant and animal life, and by chemical action involving direct precipitation of carbonate minerals from alkaline solutions. Carbonate minerals may also form by accumulation of calcareous deposits in inland fresh-water lakes and sedimentary basins. Great thicknesses of calcareous deposits over wide areas are noted in some regions where conditions have been especially favorable for their formation. Subsequent weathering and erosion of such accumulations may result in sandstone deposits composed largely of fragments of carbonate minerals which have porosity and permeability comparable with siliceous sandstones.

Wilhelm[11] classifies calcareous rocks in six different groups based on the manner in which they are formed: (1) accumulations of the skeletal and protective structures of various marine organisms, such as sponges, corals, crinoids, coquina and shell breccia that lived in shallow seas and lagoons of former geologic ages; (2) segregations resulting from activity of bacteria on various marine organisms in shallow seas; (3) deposition due to organic chemical processes in shallow seas; (4) deposition due to physical processes creating clastic limestone sediments; (5) dolomitic limestones and dolomites formed by base exchange of calcium and magnesium; and (6) chemical change of residual anhydrite as a result of reaction with CO_2 aided by bacterial action.

Porosity in calcareous rocks is a result of the primary conditions of deposition and subsequent secondary alterations that may either enlarge or reduce the size of the pore openings. The pore spaces in limestone reservoir rocks are extremely variable in size, shape and distribution, depending upon the manner in which they are formed. Howard[5] classifies limestones as (1) limestones with primary porosity; (2) limestones with secondary porosity; and (3) fractured limestones. Chalk, oölitic limestone, coral reefs and primary crystalline limestone have primary porosity. Secondary porosity is a result of solution effects and mineralogic changes. Fractured limestones result from the effects of structural deformation of brittle, strongly jointed types of calcareous rocks. It appears likely that most limestones derive their porosity from secondary influences, usually by solution and weathering of former erosion surfaces. Acid waters circulating below erosion surfaces dissolve fossil remains and enlarge joint and bedding planes, the remaining material enclosing spongy, vesicular, even cavernous openings in which oil and gas may accumulate.

Limestone, composed largely of calcium carbonate in one or another of its mineralogical forms, is readily soluble in dilute solutions of carbonic, organic, sulphuric and other acids. Meteoric waters circulating in near-surface sedimentary formations, are frequently weakly acid in character and attack the more soluble portions of the limestone deposits to which



they have access, increasing the porosity and permeability in the formations through which they flow. Such conditions are especially favorable at outcrops above the prevailing ground-water level. Zones of porous and permeable limestone, so formed at former outcrops, may later be covered with sedimentary strata and thus appear immediately below stratigraphic unconformities. It is believed that a large percentage of petroliferous limestone reservoir rocks have been formed in this way. In other cases, limestone masses are composed largely of fossil accumulations of former plant and animal life and subsequent solution of the more soluble portions leaves casts of shell-like forms, developing a high percentage porosity and more or less continuous permeability. Coölitic limestones and coral reefs of this character provide excellent oil reservoir rocks in some regions.

Chemical reactions responsible for formation of porosity and permeability in limestone formations are readily reversible. Below the ground-water level, alkaline conditions generally prevail, often resulting in precipitation and deposition of carbonates in the pore spaces of sedimentary strata. Thus, the porosity of formerly high porous formations may be reduced. Secondary carbonate minerals deposited from connate or circulating meteoric alkaline ground waters, often provide the cementing material in otherwise siliceous sandstones.

Dolomitic reservoir rocks, composed largely of magnesium carbonate, are considerably less soluble than the calcium carbonates. Yet they often have well developed porosity and permeability. It is generally believed that this may be due to a process of chemical replacement of calcium by magnesium in calcareous formations, which results in a shrinkage of some 12 to 13 per cent in the volume of the rock. However, it appears that in many instances, porosity in dolomitic rocks is developed by solution effects, as in the case of limestones.

It is apparent that the porosity of some calcareous formations has been a result of secondary agencies, such as deformation of earth strata resulting in fracturing of rock masses. Limestones and dolomites are rather brittle rocks that readily fracture along crystalline boundaries and joint and cleavage planes, and when subjected to deformation by earth forces, often form brecciated masses which afford good reservoir conditions for oil and gas accumulation.

Laboratory studies of porosity in calcareous rocks indicate that the percentage porosity and size and shape of the pore spaces are extremely variable. In some cases, limestone reservoir rocks appear to be honeycombed with large and continuous solution cavities that result in a very high percentage porosity and permeability. The size of the openings range from vast open caverns to subcapillary openings too small to permit of movement of fluids through

(Continued on page 84)

Temporary staff quarters at the refinery site. (All photos used in this article courtesy of California Texas Oil Co. Ltd.)

The character and way of life in India's second largest east coast port is changing rapidly as a result of the building of a $25 million refinery by Caltex.

A Changing

PAST and present are meeting in harmony in the city of Visakhapatnam, a port half way up India's east coast on the Bay of Bengal.

Here, in a community dotted with palm groves and low stone or stucco buildings with thatched or tile roofs, Caltex Oil Refining (India) Ltd. is building a $25,000,000 refinery that is gradually changing both a landscape and a way of life. Bullock carts, reminders of a bygone age, are still there, but mighty bulldozers and masses of modern construction equipment have arrived to dig foundations and raise the towers of the modern, 13,500 b/d plant that is scheduled to go on stream next year on a 370-acre site just outside the city.

Work on the refinery buildings started a little over six months ago. Several thousands of tons of earth have been shifted, the whole area drained and approximately 3,600 trees felled. The change within this short time is astonishing. The contours of Visakhapatnam's "new industrial look" are already visible.

When in operation the refinery will produce gasoline, kerosine, diesel oil, aircraft jet fuel, and the heavier types of fuel. It will have a two-stage crude distillation unit, a propane decarbonization unit, a catalytic cracking unit, a polymerization unit, and allied facilities.

Refined products will be distributed in the immediate area south of Visakhapatnam and will also be shipped to Calcutta, some 450 miles away, and from Calcutta further inland into West Bengal and the surrounding territories.

The immediate economic advantages of an oil refinery are obvious. A variety of refined products become available within the frontiers of the country to save valuable foreign exchange so urgently needed to purchase heavy equipment and specialized services to fulfill India's industrial production targets under the Five Year Plans.

Secondary advantages are of equal significance. A large-scale project like an oil refinery automatically stimulates a number of other industries by using their products. For instance, the Caltex oil refinery will have used 16,000 tons of cement and several thousand tons of steel in terms of pipes, rods and other construction materials by the time it goes on stream. These are but two examples from an imposing list of commodities which will be used. It is computed that approximately $1,400,000 will be spent on the local purchase of materials for the operating plant. An expenditure of this magnitude must inevitably result in increased economic activity over a wide field.

These benefits are not confined to large-scale industries. The individual citizen, too, is given his opportunities; several people have gone into businesses that depend directly or indirectly on the construction program.

After Calcutta and Madras, Visakhapatnam is the most important port on the east coast of India. Its principal exports are manganese ore and tobacco. The refinery will involve further port expansion. Two oil berths 600 feet in length will be constructed. Meanwhile, operations to dredge the harbor channel and turning basin to accommodate deep draft ships are underway.

In addition, a mile and a quarter spur railway will connect the refinery with the main line of the South-eastern Railway, which runs between Calcutta and Madras.

The Caltex refinery will be a principal customer of the government sponsored

General view of the refinery site. Hundreds of workers are seen, center, laying tank pads.

VISAKHAPATNAM

Building railroad spur inside east boundary of refinery.

water and electric supply projects. Since Visakhapatnam depends entirely on the vagaries of the monsoon for its supply of fresh water, it is planned to lay a 26-inch water main from the Gosthani River, some 25 miles away, which will relieve the present water scarcity. Approximately 25% of this water will be used by the refinery, so company payments will substantially finance the new pipe line. Similarly, a new hydro-electric project at Machkund will be the principal source of power for refinery operations.

Of the numerous construction workers now employed at the refinery site, some are learning skilled trades under British, American and Indian supervision. As a result, while only a limited number will remain as permanent staff, quite a few are becoming expert welders and mechanics. A new future awaits them—vastly different from their past as unskilled laborers. Some will even be sent abroad for training in other Caltex refineries.

Hitherto, the local shipyard has been the only large scale organized industry in Visakhapatnam's agricultural economy. The yard employs 3,500 workers. Other, smaller industries are jute, tobacco, and sugar.

Visakhapatnam today has become an oil conscious town. Some look to the refinery for employment, others seek to trade with it while yet others look forward to the many indirect advantages which a large investment must bring. There is an air of expectancy, and daily progress at the refinery site is the news of the day for the local bazaar. More, perhaps, there is a sense of urgency and a new appreciation of speed and efficiency. In estimating the future, local tradesmen are thinking in terms of "planned and coordinated purchases" from their wholesalers in Calcutta and Madras as existing stocks, accumulated over a period of time, are dwindling away.

The town of Visakhapatnam, too, looks forward to an era of prosperity. With increased employment and a step-up in industrial activity more purchasing power will be available and local tradesmen expect a correspondingly increasing turnover.

It would be wrong to suggest that the Caltex installation will be an open sesame to untold wealth and riches for the people of Visakhapatnam but if the project succeeds, as it must, in stimulating economic activity and in giving an impetus to the industrial development of the country and contributes to that extent in raising living standards, then the refinery will have played its part in the building of the new India. END

Trainees learning to weld at the fabricating shop.

Bullock carts from Visakhapatnam, bringing in bricks to the refinery site.

Cuban oil company ties stock selling campaign to national lottery

By Ruth Sheldon Knowles

WHAT would happen if you took the world's greatest gambling game—oil finding—and combined it with the world's most popular system of gambling—the lottery?

A month ago this would have been an idle question of the hot-weather, parlor-game variety. Today you can find some surprising answers to it in Cuba, where a group of Cuban business-men obtained government blessing to blend these two irresistible forms of chance-taking into as unique an offering to Lady Luck as man has yet come up with in his centuries of devotion to her.

This bright new approach to speculation has important implications. Serious thinkers view it as a stabilizing influence on the future of Cuba's budding new oil industry and an unusually effective method of selling the principles of private enterprise to a nation.

The Cuban project is not just a lottery. It sells shares of Cuban oil companies. The lottery angle is like the free trip to Paris you might win if you send in your name on the soap wrapper. Even if you don't get to Paris you can still keep clean. If the serial number on the share of oil company stock you buy isn't a winner of one of the monthly prizes ($25,000), first prize; $10,000, second, $5,000, third; with winning numbers those of the national government lottery), you are still a shareowner in a Cuban oil exploration venture with a new prize-winning angle coming up—the possibility of an oil discovery increasing the value of your shares. Next month you can buy more shares and have a whack at next month's prizes. You can figure your odds, too, as only 40,000 shares are sold a month at $5 a whole share or $1 for 1/5th of a share. The jealousy of Las Vegas gamblers over this idea will only be exceeded by that of American stockbrokers.

Its originator, Compania Financiera de Petroleo La Fortuna, S.A., last month began sales of Cuban oil stock to the general public. Operating under an exclusive government franchise for six years, their salesmen started operations simultaneously in every province of Cuba. Popular response was tremendous for in Cuba everyone would rather gamble than eat.

Oddly enough, the lottery angle is not emphasized—possibly because it doesn't need to be. It's sure fire. What La Fortuna does talk about and advertise is the fact it is offering the public an opportunity to invest for themselves and for Cuba. "For as little as one dollar you can become a shareowner with voice and vote in a Cuban oil company" is their theme song. They stress the fact that Cuba has great oil potentialities, yet it imports 55,000 barrels of oil a day. "Just as the people of Cuba obtained their political independence, they can assure their economic independence," they point out. "By producing our own oil we can develop new industries, create new jobs and bring to Cuba the greatest prosperity our nation has ever known, a prosperity in which you can participate directly."

To further demonstrate the serious policy of La Fortuna, the first Cuban oil company whose shares are being sold is Yacimientos Petroliferas, S.A., a new exploration company whose executive vice president is Glen Ruby, famed geologist-oil finder.

Mr. Ruby hasn't just climbed on the current Cuban oil boom bandwagon. He helped build it. In 1947, when the major oil companies were abandoning Cuba, he made a geological report for the Cuban government highly recommending Cuba's oil potentialities. He is also consulting geologist for Ted Jones Enterprises of California, which has developed new production east of Havana, part of which was recently purchased by Kewanee Oil Company. He is a spectacular oil finder, having discovered the world's southernmost oil field in Chile and the northernmost field—the Navy's 100 million barrel reserve Umiat field at Point Barrow, Alaska. He has been geological consultant for the governments of Argentina, China, Chile and Portugal, and done work in Venezuela, Paraguay, Peru, Brazil and Costa Rica.

With the special brand of humor that is the Ruby trademark in the geological profession, he maintains that he has now retired. "In order to retire you have to have a hobby," he says, "so I have decided to work on complicated geological problems as my hobby." As Yacimientos Petrolifera's concessions are in practically every province of Cuba, Mr. Ruby will have a wide field in which to exercise his "hobby."

With the American public already avidly speculating on small Cuban oil company stocks listed on the American Stock Exchange, none of whom have associated with them as well known a scientist as Mr. Ruby, it is no wonder that the Cuban public is rushing to invest for itself and Cuba by buying oil shares which have the added attraction of monthly lottery prizes.

Thousands of Cubans who would probably never have become a shareowner in a company of any kind are now getting their first experience with the formula of private enterprise development of their country's resources. Through La Fortuna's nation-wide publicity campaign they are being told for the first time what stock ownership means and why they as Cubans should participate in their country's development. They are being educated as to the problems of exploring for oil and what the oil industry is. Through the efforts of La Fortuna a greater percentage of Cubans will have a direct participation in and personal preoccupation with the development of Cuba's oil resources, than is the case of the national of any country outside the United States.

Stock participation is the only method whereby the average citizen *can* participate in oil development in countries where the government owns the subsoil and this is the first time that any company has ever dedicated itself to a campaign to get everybody possible in an entire country to invest in oil development. The resulting distribution is enough to make any investment banker drool and raise the fever point of any public relations counsellor.

La Fortuna is ploughing and fertilizing a

(Continued on page 78)

NEWALLS OFFER COMPLETE TECHNICAL SERVICE

NEWALLS are constantly expanding the scope of their technical service. Founded on 50 years of success in industrial insulation on land and sea they provide expert guidance on refinery insulation all over the world.

Newalls cover much more than the supply of first-class insulating materials. From plant conception to installation, and afterwards, Newalls offer a complete service on insulation problems. Our technical staff are ready to handle the specifications and estimation work for any type of plant, large or small, and provide skilled supervision on site. Calling in our technical service ensures optimum performance.

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Petrofina, Antwerp.

BRAZIL
Cubatao

FRANCE
Berre
Donges
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Gonfreville
Lavera
Petite Couronne
Port Jerome

INDIA
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London Letter

By E. Lawson Lomax

The most important recent British oil news is the proposed sale of the British-owned Trinidad Oil Company, formerly Trinidad Leaseholds, to The Texas Company.

The news created considerable discussion, much of it because the Texas Company offer of $176.4 million for the Trinidad Oil interests did not seem to bear any direct ratio to the stock value which, at the time the news broke, was quoted at 41 shillings and six pence per share as against a value of eighty shillings and three pence assumed in the deal.

Another bone of contention was that this sale meant the disposal of the only fully British-owned oil company to foreign interests. The oil industry however is international and must essentially remain so. This being the case, the fact that an American company should own and operate the oil resources of a British Colony, does not seem strange to oil men. Modern petroleum exploration and development are of such a nature also as to require vast capital sums, if it is to be carried out successfully. A comparatively small company like the Trinidad company does not have these resources, and therefore is not in the same position to carry out a development program as is a company with larger resources like The Texas Company.

The island of Trinidad has been extensively explored during the past half century by the various companies established there, and there would appear to be little possibility of largely increased onshore production in the future. On the other hand there are possibilities of offshore production, and these possibilities have no doubt influenced The Texas Company.

After an extended debate in Parliament, no Government embargo was placed on the sale, which is now following the ordinary course of such a deal by a call for individual acceptance by the shareholders, and modification of certain documents relating to leases and other rights, which according to arrangements have all to be completed by August 31, 1956.

As soon as the sale has been completed, Mr. Vos, Chairman of Trinidad, is to resign, and it is understood that on resignation he will be granted compensation to the extent of £50,000 ($140,000).

UK Oil Use Up 12% During 1956

Figures by the Petroleum Information Bureau show an increase in petroleum consumption of almost 12% in the first quarter of 1956, over a similar period in 1955. That is, 6,529,491 tons as against 5,836,978 tons.

There was a rise of almost 24% in the consumption of residual fuel oil, the largest increase of any individual fuel, which shows a tendency in industry to exchange petroleum for fuel at the expense of coal. The demand for kerosine rose by nearly 22% owing to the exceedingly cold spell of weather experienced in February.

The only product showing a decline in consumption was vaporizing oil, which is mainly used as tractor fuel, diesel engined tractors becoming more popular than ordinary motor engines.

Esso Adds Butyl-Rubber Plant

A proposal is on foot by the Esso Petroleum Co. for addition of a butyl-rubber plant at its Fawley refinery. This butyl rubber is produced in the U.S.A. and marketed by the Enjay Co. under the name Enjay Butyl.

This announcement follows one by Esso in May regarding the additions to be made to the Fawley refinery in order for the company to enter into the petrochemical industry, and for plant to be erected at a cost of about £5 million for the production of GR-S rubber, by the International Synthetic Rubber Co. formed by Dunlop.

British Equipment Sales Higher

Oil companies in the United Kingdom placed orders for equipment valued at £38.5 million in the first quarter of this year according to an announcement by the Council of British Manufacturers of Petroleum Equipment. The total compares with £32.8 million in the first quarter of 1955 and £30.4 million in the final quarter of last year. Total for the year was £123.5 million. Details of first quarter purchases follow:

	Value
	£
1—Geophysical and other Exploratory Equipment, etc.	20,049
2—Specialized Equipment for Oil Drilling and Production, including Oil Casing, Tubing, etc.	3,713,084
3—Specialized Equipment for Oil Refineries, etc. (not including pumps and valves).	1,372,749
4—Drum and Can-making, Filling and Cleaning Equipment, Kerbside Pumps and other Oil Metering and Dispensing Equipment, etc.	279,349
5—Railcars, Road Tankers, Aircraft Refuellers, etc.	77,960
6—Drums, Drumsheets and Tinplate	2,025,712
7—Tankage (including Tank Fittings)	1,608,439
8—Tubulars, Pipe Fittings and Valves (Ferrous and Non-Ferrous)	8,043,834
9—Pumps, (excluding Slush, Oilwell and Kerbside)	515,406
10—Boilers, Boiler House Plant and Accessories, etc.	264,465
11—Electrical Equipment—Motors, Generators, Transformers, etc.	1,752,090
12—Instruments, Meters and Gauges, etc.	421,898
13—Prime Movers and Compressors	387,614
14—Machine and Hand Tools, Welding and Miscellaneous Machinery and Stores	2,440,352
15—Ferrous and Non-Ferrous Plates, Sections, Sheets and Bars	2,219,083
16—Automotive Equipment, all types	2,193,909
17—Laboratory Equipment and Chemicals including Hospital and Medical Supplies	239,735
18—Bulk Chemicals, Catalysts, Barytes, etc.	7,390,387
19—Cement and other Building Materials and Hardware including Timber	1,302,622
20—Commissary, General Requisites for Office, Warehouse, Household, Club and Sports, etc.	2,221,258
	£38,489,995

Kuwait Oil Head Honored

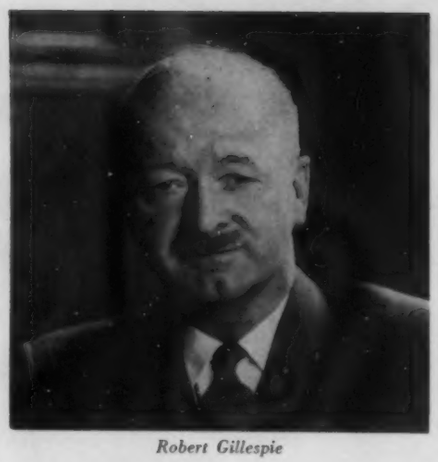
The grade of Knight of the Order of the Hospital of St. John of Jerusalem has been given to Archibald Philip Southwell, director of the Kuwait Oil Company Ltd.

New Tanker Launchings and Deliveries

The 21,500 dwt combined oil and ore carrier M.S. "Soya-Pacific" was launched May 31st, built to the order of Rederi AB Soya of Stockholm. The 33,000 dwt tanker "Cheverny," was launched from the yard of Ateliers et Chantiers de France, Dunkirk on June 9th, built to the order of Societe Francais des Petroles BP.

The 24,800 dwt S.T. tanker "London Valour" was launched at Haverton Hill shipyard of Furness Shipbuilding Co. on June 12th. The 18,000 dwt S.T. tanker "San Flaviano" was launched from the Birkenhead Shipyard of Cammell Laird & Co. on June 12th, built to the order of the Eagle Tanker Co. Ltd.

The M.T. "Visund," 17,300 dwt, built for Skibs A/S Nordheim and A/S Skagerach, Oslo, was delivered June 4th 1956. S.S. "Samuel Ugelstad," 31,840 dwt built by Furness Shipbuilding Co. at Haverton Hill Shipyard for S. Ugelstads Rederi A/S of Norway, was delivered June 13th, 1956. S.T. "Solfonn," 29,650 dwt, built by Harland & Wolff Ltd. at their Belfast Shipyard to the order of Skibs A/S Dalfonn (Sigval Bergesen) of Stavanger, Norway, was delivered June 15th 1956.



Robert Gillespie

Changes at British Petroleum

E.H.O. Elkington, M.C., has retired from the board of British Petroleum, and Robert Gillespie has been appointed managing director.

Mr. Elkington joined British Petroleum Co. (then Anglo-Persian Oil Company) in 1921 in Persia. He joined the company's head-office management in London in 1947. Mr. Robert Gillespie joined the British Tanker Company (now the BP Tanker Company) in 1932. He was appointed general manager of the British Tanker Company in 1944, becoming a director in 1946 and managing director in 1950.

L. C. Musgrave, assistant marine manager, has been appointed deputy marine manager of Esso Petroleum Company, Ltd. F. H. Mee and P. R. Fairbairn have been appointed assistant marine managers.

The M.T. "Tank Duchess" 20,000 dwt built by Fredriksstad Mek. Verksted to the order of Sigurd Horlofson and Co. A/S, Oslo was delivered June 16th, 1956. M.T. "Synia," 19,400 dwt, built by Gotaverken Shipyard, Goteborg, Sweden to the order of Waages Tankrederi A/S and Waages Tankrederi II A/S, Oslo was delivered June 28th, 1956.

Large Fuel Efficiency Show in London

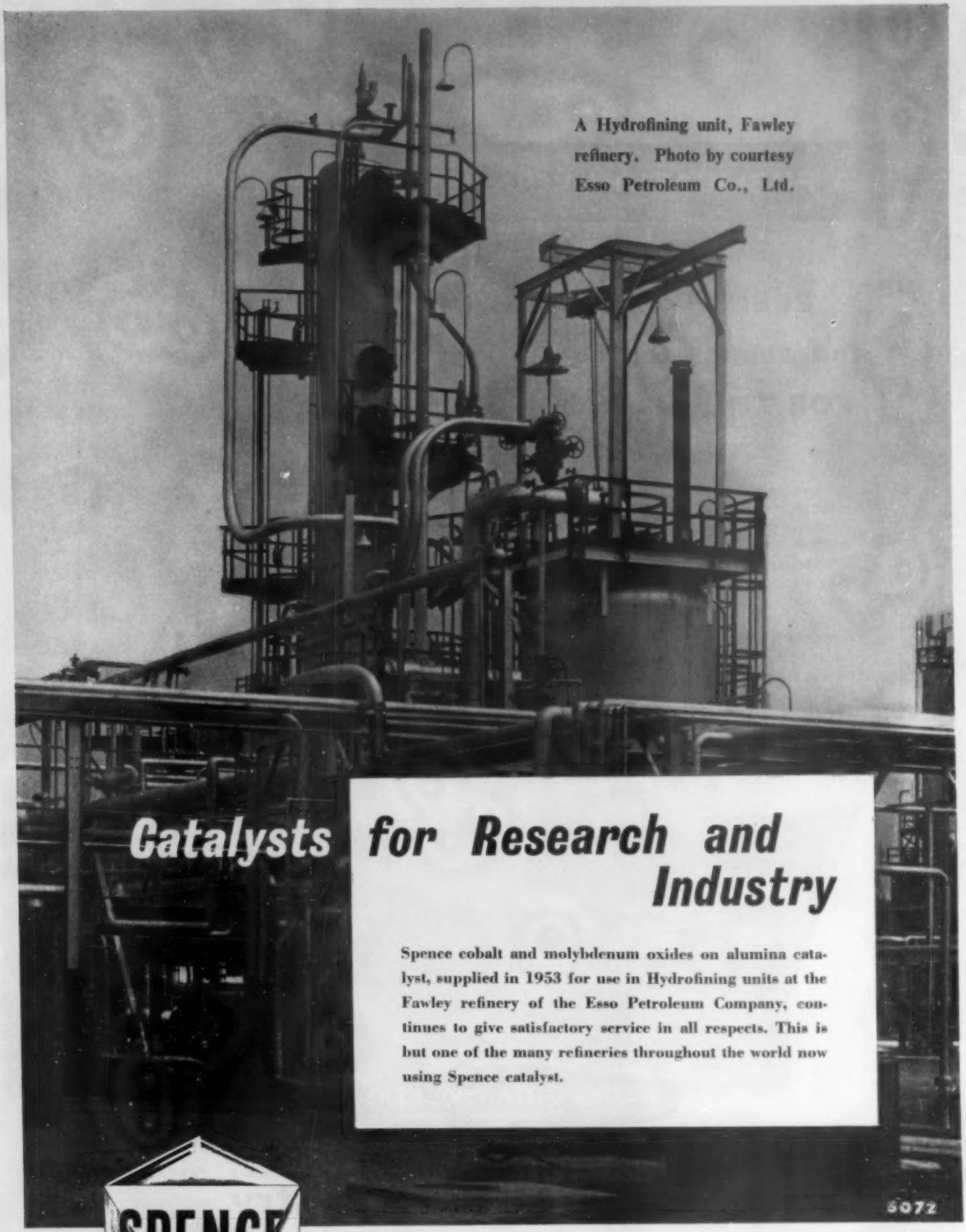
The Fuel Efficiency Exhibition will be opened Oct. 2-10, by the Minister of Fuel and Power in London. The show will be the largest of its kind in the world. Altogether about 150 firms will be showing special equipment designed to produce fuel economy in all branches of industry. The equipment shown will include the latest types of fuel burning devices for both solid and liquid fuel; self-contained, automatic-controlled, oil-fired boilers; the latest developments in insulating materials; and every conceivable type of automatic-control equipment. All are designed with the object of reducing fuel costs.

Institute of Fuel

John R. Rylands succeeds R. H. Gummer as president of the Institute of Fuel in October 1956. Mr. Rylands served in World War I in the Middlesex Regiment and on demobilization returned to Leeds University, graduating 1st Class Honors B.Sc. Engineering in 1921, and proceeding to M.Sc. in 1926. He has had a wide experience in engineering and has paid special attention to fuel economy. He is now chief engineer and director of E. Green & Son Ltd., Wakefield, fuel economizer makers.

New Commodore of BP Tanker Company's Fleet

Captain Surrey Douglas Bumstead, has been appointed commodore of the BP Tanker Company's fleet (the shipping organization of the British Petroleum Group). He was appointed one of the Company's senior post masters in October 1952 and now succeeds as commodore Captain W. A. Michie who has recently retired after 44 years' service at sea, of which almost 38 years have been with BP Tanker Company.



A Hydrofining unit, Fawley refinery. Photo by courtesy Esso Petroleum Co., Ltd.

Catalysts for Research and Industry

Spence cobalt and molybdenum oxides on alumina catalyst, supplied in 1953 for use in Hydrofining units at the Fawley refinery of the Esso Petroleum Company, continues to give satisfactory service in all respects. This is but one of the many refineries throughout the world now using Spence catalyst.

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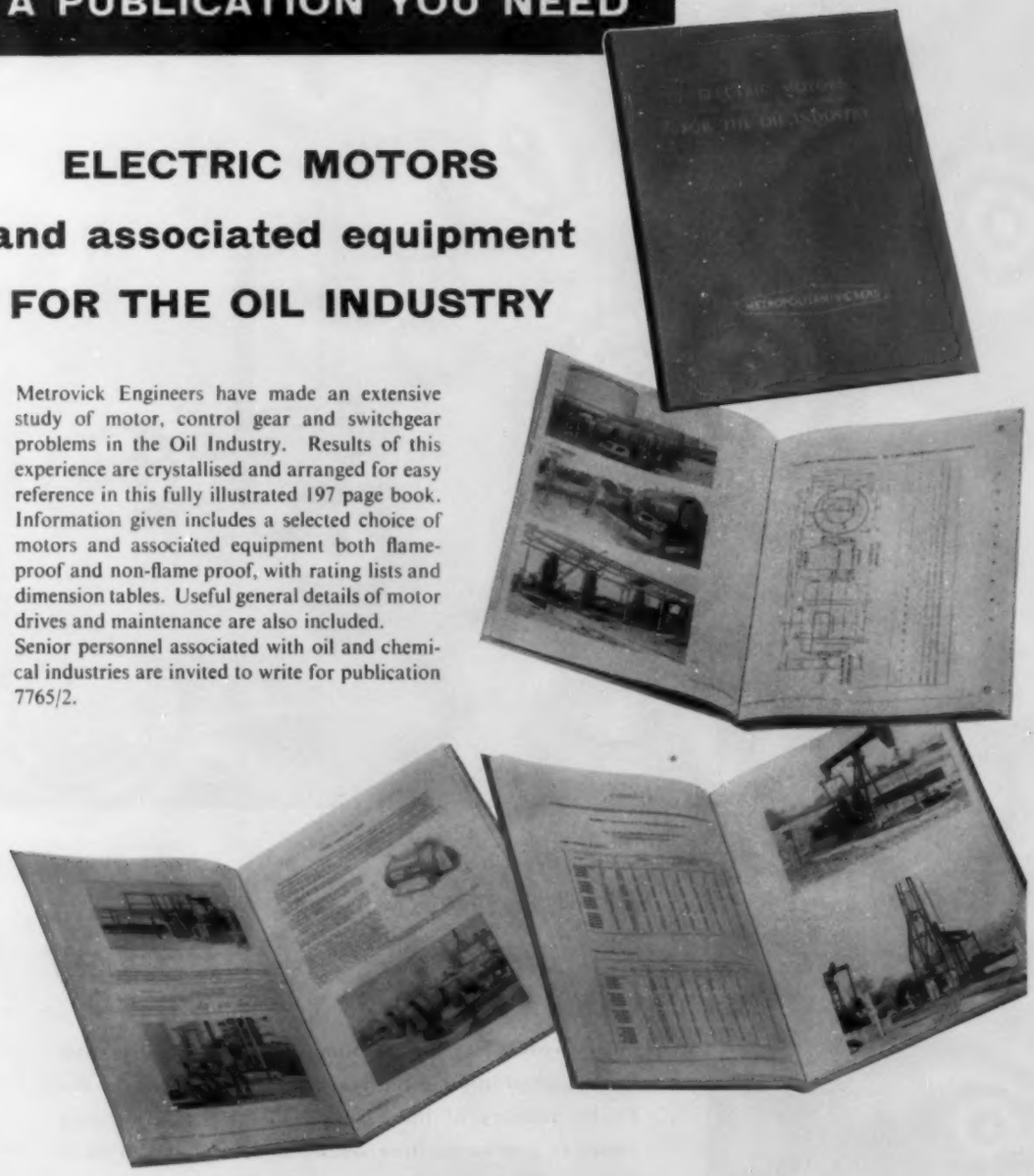

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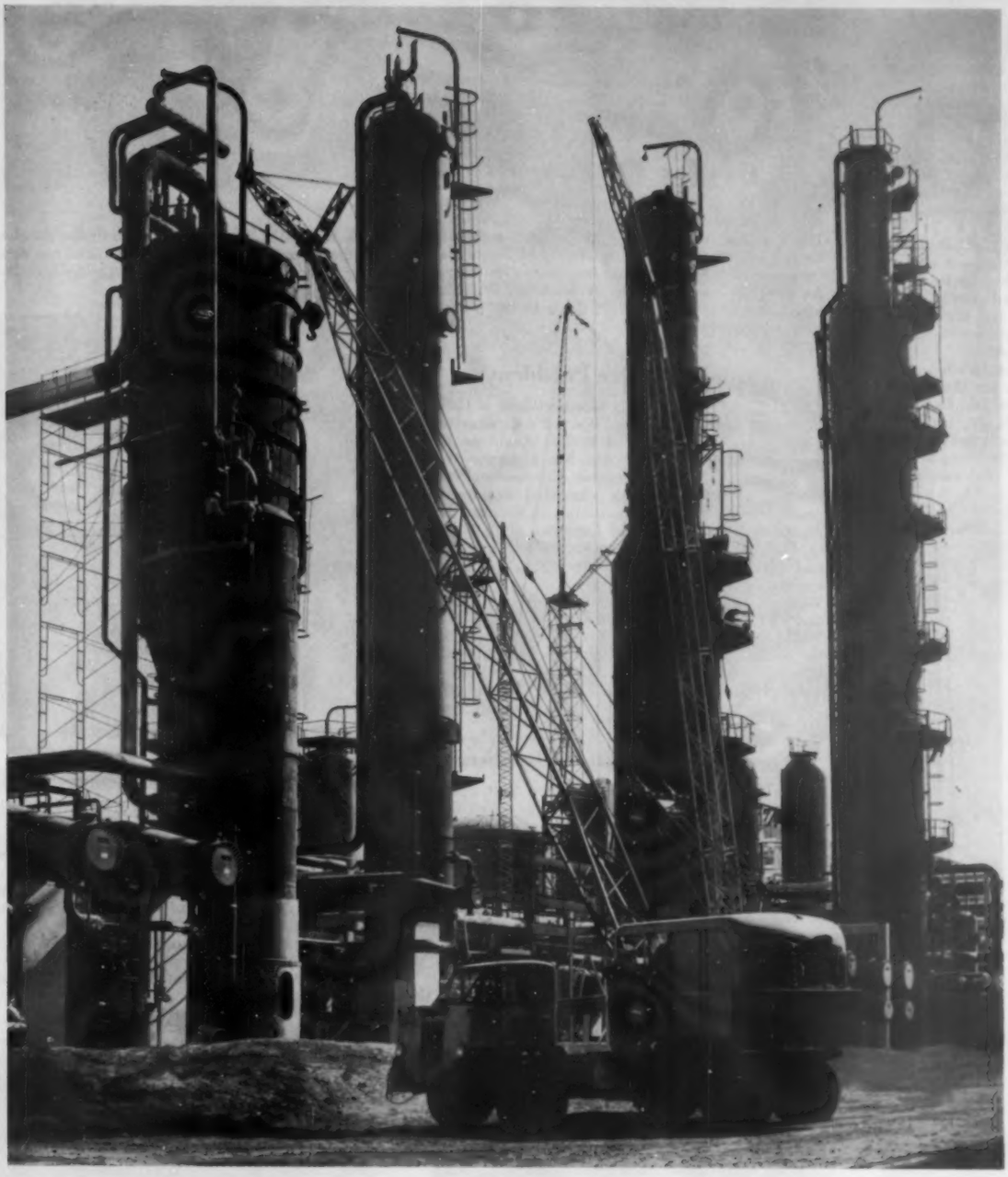

AMONG THE GIANTS

Like the "everlasting redwoods" that grow nearby, towering columns of steel push into the California sky at Tidewater Oil Company's Avon Flying A Refinery. The vessels are units of a major expansion, undertaken to meet the continuous growth in demand for high quality Flying A products. Among other facilities, the program includes a 42,000-barrel Fluid Coking Plant, world's largest.

The Avon Flying A Refinery project is a Bechtel responsibility—design, procurement, construction.

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BECHTEL

Oil Company Staff Changes

CALDWELL STARKEY has been named district geologist for Jamaican Stanolind Oil Co. at Kingston, Jamaica.

COLONEL WENDELL W. FERTIG (retired) has joined the firm of Ball Associates, consultants in oil, gas and minerals.

R. SCOTT GRAHAM, petroleum engineer, is now associated with John S. Herold, Inc. Mr. Graham was formerly with Creole Petroleum Corp. and Carter Oil Co., both affiliates of Standard Oil Co. (N.J.), as a production and reservoir engineer.

ROBERT P. MANGOLD has been appointed manager of field operations of Reserve Oil and Gas Co., replacing Max C. Eastman, who was recently promoted to executive vice president at San Francisco. Mr. Mangold will be stationed at reserve's field office in Bakersfield.

C. M. DECKARD, controller, and T. C. Buchanan, manager of supply and transportation, are two officials of the Oasis Oil Co., which will be headquartered in Tripoli. The Oasic, owned jointly by the Ohio Oil Co., Continental Oil Co. and the Amerada Petroleum Corp. was formed to explore a 35-million-acre concession in Libya, North Africa.

Dr. WILLIAM A. GORMAN, exploration geologist at Drilling & Exploration Co. for the last two years; George I. McFerron, for the last four years chief geologist; and E. A. Roberts, Jr., production manager and coordinator of the engineering, producing and purchasing departments, have all been named vice presidents. They will also continue to serve in their respective capacities.

J. S. LEACH, chairman of The Texas Co., will retire from active service on Oct. 1, 1956. Augustus C. Long, president of the company since March, 1953, has been elected chairman and chief executive officer, effective on that date. James W. Foley, executive vice president since June 1955, will succeed Mr. Long as president.

Upon his retirement in October, Mr. Leach will have completed 40 years of service with Texaco. He will continue as a director.

Mr. Long joined the company in 1930, and served both in the domestic and foreign departments until he became executive vice-president in 1951. He was elected vice president in charge of foreign operations—eastern hemisphere in 1949, and a director a year later. In March, 1953, Mr. Long was elected president and a member of the executive committee. He is also a director of a number of subsidiaries and affiliated companies of Texaco.

Mr. Foley joined Texaco in 1932. Following service with affiliated companies abroad, he held various positions in the domestic producing department. In 1950 he was appointed assistant to the chairman. He was elected a vice president in 1953, a director in September, 1954, and executive vice president in June, 1955. He is also a director of several Texaco subsidiaries and affiliated companies.

ROBERT L. GOLLUM has been named co-ordinator of producing department purchases of Socony Mobil Oil Co. He joined the producing department as assistant to the materials supervisor in 1946. In 1948 he was promoted to assistant co-ordinator of materials and in 1952 was made supervisor of that section, the position he held until his present promotion.

CHARLES A. PERLITZ, Jr. senior vice president and a director of Continental Oil Co., has been elected executive vice president.

Transferred To Venezuela

W. C. Summy, former assistant division production superintendent for Sinclair Oil & Gas Co. at Houston, has transferred to Sinclair Oil & Refining Co. in Venezuela as superintendent of Santa Barbara operations. Mr. Summy has been with Sinclair for over 29 years, working in Seminole, Wyoming, Oklahoma City and the Gulf Coast in the production department.

Appointed Vice President

E. D. Loughney, formerly vice president of Canadian Gulf Oil Co., has been elected a director and appointed vice president of British American Oil, with headquarters in Toronto. Mr. Loughney will be responsible for the executive direction and control of British American's expanded exploration, production and pipe line activities in Canada, as a result of the acquisition of Canadian Gulf Oil Co. O. I. Torkelsen has been appointed vice-president and general manager of the company's enlarged exploration, production and pipe line operations in Western Canada, including those formerly conducted by Canadian Gulf Oil Co.

RALPH NEUHAUS, vice president of Associated Oil & Gas Co. and general manager of Associated Oil Field Rentals, died at his home in Houston on June 16 after a brief illness. He had been prominently identified with the oil industry for 35 years.

Personnel Changes At Schlumberger

William Plasch has been appointed Taft district manager in California for Schlumberger Well Surveying Corp. J. W. Chance is now manager of the Jennings, Louisiana location. The new manager of the Electra, Texas location is J. K. Ryan, a Schlumberger employee since 1950. The manager in Big Lake, Texas is now Roy R. Shourd, Jr.

W. W. Goode has been named assistant manager of the Southeast Area in New Orleans. Formerly, he was Permian Basin division manager at Midland. D. L. Bryan has replaced Mr. Goode in Midland.

G. K. Whitley

G. K. WHITLEY, a Texan and a driller-in-charge of the Assam Oil Co. in northeast India, has retired after more than 30 years service in oilfields in India, Burma and Pakistan.

Cliff W. Peery

CLIFF W. PEERY has been elected vice president of the Mene Grande Oil Co. A veteran of 22 years service with Mene Grande, Mr. Peery received his Bachelor of Science degree in Petroleum Engineering at the University of Oklahoma in 1933. He was sent to Eastern Venezuela as geologist for the Venezuela Gulf Oil Co. in 1934. Mr. Peery's work with the company was interrupted by the war in January 1943. He served for three years with the U. S. Marine Corp. On his return to Venezuela in 1947, he resumed his former position as assistant superintendent of the production department. Last year, Mr. Peery was transferred to Caracas to become manager of operations for the company.

J. S. Leach

A. C. Long

J. W. Foley

A STERN VIEW
of
Petroleum Progress

Though it dwarfs the once mighty tankers of ten years ago, this huge Cities Service super tanker **may** some day be dwarfed itself. That is the enigma of size and the essence of progress...the reason why we constantly strive to better our works, no matter how great they seem to ourselves.

In this light, Cities Service views its current record: The all-time high in petroleum production . . . the one-out-of-three success ratio in test well drilling—far above the ratio for the industry . . . the new peak in stockholders' equity . . . and the soaring sales of Cities Service petroleum products.

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CITIES SERVICE

Progress through Service

Latin American Oil News

Oil Company Ties Stock Selling Campaign to Cuban Lottery

(*Continued from page* 70)

field of public education from which all oil companies in Cuba, both Cuban and American, may reap a rich harvest of public support. Some observers believe that if American oil companies operating abroad had concentrated in the early years on encouraging nations to become shareowners of their companies, the plagues of expropriation, restrictive legislation and exclusion might have either been avoided or alleviated.

La Fortuna is unique in its educational and private enterprise aspects, but it has precedent in public money raising. Outside the United States, governments have long recognized that the most attractive way to raise money is through lotteries —of the loser losing all variety. However, in recent years they have applied the lottery system to selling bonds. A current survey by the Wall Street Journal shows that Norway, Sweden, Denmark, Finland, France, Belgium, Italy and Greece are selling their bonds by lottery. "Communist Russia assertedly raises billions of dollars at a whack by running bond lotteries," the Journal reports. And even the conservative British, after much debate, will begin in November to apply this type of sugar coating to the bitter pill of extracting more money from tax-weary Britons.

La Fortuna apparently has the blessing of its trademark, Lady Luck, for the same week its oil company shares went on sale throughout Cuba, Cuba American Drilling and Exploration Co. made an estimated 30 barrels an hour wildcat discovery of 35 gravity oil at 7,100 feet in Cuba's central basin. Interest in Cuban oil prospects zoomed to a new high. With more than $35 million committed to exploration during the next five years on concessions covering practically all of Cuba on and offshore (see WORLD PETROLEUM, October, 1955, and March, 1956 for full details and maps), this is only the first of what the wildcatters hope will be a series of discoveries. It proves the contention that Cuba does not lack oil—only enough wells to find it.

The addition of such new companies as Yacimientos Petroliferas to the growing list of Cuban explorers, both major and independent, further assures the discovery of Cuba's potentialities, for the key to oil finding, as Dr. E. DeGolyer points out, is multiplicity of effort. Dr. DeGolyer is also responsible for the off-quoted statement that "Cuba has more physical evidence of petroleum than any other country in the world."

Another observation of his is that "oil finding is like gin rummy. Skill alone will never win—but luck enough will." Any wildcatter will tell you he would rather be lucky than scientific. The stress on luck has perhaps been carried to the ultimate by the president of one of the largest American independent oil companies who has such a superstition about the importance of the number "13" in his oilfinding luck that he built a building for his company of only 13 stories, the 13th floor being the executive office of which there are only 13 rooms and the number of his own office being 1313.

With oil men themselves leaning so heavily to the side of luck versus science, the public cannot be blamed for leaping at the chance to try their luck on such a double-barreled basis by (a) buying shares in oil companies where their company might find big oil in a country that is acknowledged as a potential big oil province, and (b) where they know they stand a chance of winning a fixed money prize each month. Gamblers never had it so good Even if they figure the odds on both lottery and oil finding.

Appropriately enough, one of the best stories on odds happened in Cuba. In his book, *This Was Racing*, Joe Palmer relates the tale of an American in Havana who, after a night's gambling, "came out into the cold gray light of morning with several hundred miles of water and a $5 bill between him and his homeland." On the way to his hotel he met a man carrying a large fish. He asked what kind it was and the fisherman told him it was a redsnapper. The American bet $5 that it wasn't. They went to the fish market to settle the bet and when the fishmonger confirmed that it was, of course, a redsnapper, the American handed over his $5 bill. "You win," he said, "but it was still a good bet. I had every other kind of fish in the ocean running for me."

When you think that Man vs. Mama Nature has narrowed the odds of oil finding to one out of nine and even though you may have to submit the problem to Univac to get the percentage of your chances to win the lottery prize, just who do you think were at the front of the line to buy La Fortuna shares of Yacimientos Petroliferas?

That's right—American oil men! One Oklahoma wildcatter has arranged to buy $60 worth of shares every month. END

Mexican Oil Company Upheld

The first victory of private oil companies in their fight to continue operating in Mexico has been chalked up by the Compania Petrolera Veracruzana, which has obtained an injunction against cancellation by the Economy Ministry and the Petroleum Registry of its oil rights to 1,286.5 hectares in Magiscatzin, Tamaulipas.

The company, which obtained its concession in 1937, was not affected by the 1938 expropriation and has been selling all of its production to Petroleos Mexicanos. But its rights were recently cancelled on the ground it had defaulted on tax payments since 1953. CPV's lawyers, however, protested they had never been advised of the existence of such a debt, and the judge, ordered an injunction with the provision the taxes be paid.

In a similar case involving the National Oil Company, an American firm whose rights to 12,371 hectares in the Panuco zone of Veracruz were voided for non-payment of approximately 800 dollars in supposed back taxes, the Court took an entirely different view, and set aside its plea because the "cancellation was consented to by the enterprise in refusing to pay the debt." Under this decision, the company's holdings will automatically be assigned to Pemex.

Guatemalan Concessions

Representatives of major U.S. oil companies who have applied for exploration concessions here from the Guatemalan government anticipate that all such concessions will be granted not later than the last of August. To date, only one such concession has been granted. This has been to the Signal Gas and Oil Co., operating here through the Signal Exploration Co. The tract involves 677,000 acres and is located in the Lake Isabal region of Guatemala. Signal's application for concessions in that area was uncontested by other companies. The oil companies were congratulated by President Carlos Castillo Armas for having settled the problem of overlapping concession applications among themselves.

New Refinery at Colon

The Petrochemical Company, one of the two firms that recently signed contracts with the Panama government for the erection and operation of $33,000,000.00 oil refineries here, announced through their representatives that the city of Colon, Panama, on the Atlantic coast has been selected as the site for their refinery.

The announcemen was made through Herbert O. Jason of the consultant firm of Boni, Watkins, Jason & Co. of New York who have been retained by the Petrochemical Co. The Petrochemical Co. is controlled by Mr. John Shaheen and Mr. Eugene Du Pont III. The final decision for the selected site in Colon hinges on government approval.

Peruvian Exploration Active

A pick-up in petroleum exploration in Peru is hoped for after bad weather during the first three months of the year and resulting bad transportation conditions.

A total of more than 36 million acres are under concession and exploration work during the past few months has included: surveys by National Aerial Photographic Service of the Maranon and Ucayali river basins; Cerre de Pasco Corp. has sponsored flights in Oxapampa area; Peruvian Pacific Petroleum Co. is reported considering helicopter service for geologic and magnetometer work; Mobiloil Co. of Peru has completed surveys of Callaria river zone; Richmond Oil Co. has completed surveys of Petro river area, but abandoned Pastaza river work when half done; and Cerre de Pasco Corp. has contracted with William Ross Caveen Co. for preliminary work on Isconzazin river area; International Petroleum Co., Texas Petroleum Co., and Cia. Per. de Petroleum are other companies active. Under legislation of Oct. 5, 1955, the Peruvian petroleum law was changed to permit companies holding concessions of one million hectares or more to acquire an additional one million.

New Seismograph Service Manager

S. W. Fruehling has been named manager of the new Seismograph Service Corp. affiliate in Brazil. Since 1950, Mr. Fruehling has been in Billings, Montana, as party supervisor for SSC crew operations in the northern Rocky Mountain area.

Wildcat In Nicaragua

Exploratory drilling is expected to start in Nicaragua shortly on concessions held jointly by Joseph K. Coney, San Francisco tanker owner, and Miguel d'Escoto, Nicaragua's Ambassador to Italy. The exploration and exploitation rights extend until Dec. 31, 1956 at which time unexplored concessions areas must be returned to the state. The concession was renewed in June, 1955 and extends along both the Pacific and Caribbean coasts of Nicaragua, extending seven miles inland to one mile at sea. It totals roughly 15,000,000 acres. Maps of same are available through WORLD PETROLEUM.

H. Wayne Holman, oil consultant, has been retained by the concession holders and is currently studying aerial surveys of the areas preliminary to selecting drilling sites. Mr. Holman worked with the Gulf Oil Co. when they made preliminary surveys in Nicaragua in 1941.

Meanwhile, although several major oil companies have shown interest in possible petroleum deposits in Nicaragua, the Ministry of Economy has announced that no additional exploration concessions will be considered until the National Legislature considers and passes an oil law on which it is now working.

Union To Drill In Panama

San Jose, Costa Rica—The Compania Petrolera, Union Oil Company subsidiary, has halted drilling at Cocolas #1 well and is testing the well for pressure, flow and quality. Oil shows were found at 5,400 feet, but drilling continued to about 10,000 feet. One additional minor show was found at 6,500 feet but nothing further.

Officials described the results of the tests on June 21st as "very inconclusive and not very encouraging". However, they are going ahead with plans to drill Cocolas #2 approximately one kilometer from the present well.

It is also understood that Union will drill a well across the border in Panama in accordance with the terms of its concession with the Republic of Panama.

New Mexican Gas Line Proposed

The Mexican Gas Co., a private enterprise which has been distributing natural gas in Mexico since 1929, has asked the government for permission to build a gas pipe line from Monterrey to a point near Pemex' fields in northeastern Mexico. The company believes the proposed 18-inch line could provide Monterrey's constantly expanding industries with more than 3,000 mcf daily, or an increase equivalent to more than double the city's present supply.

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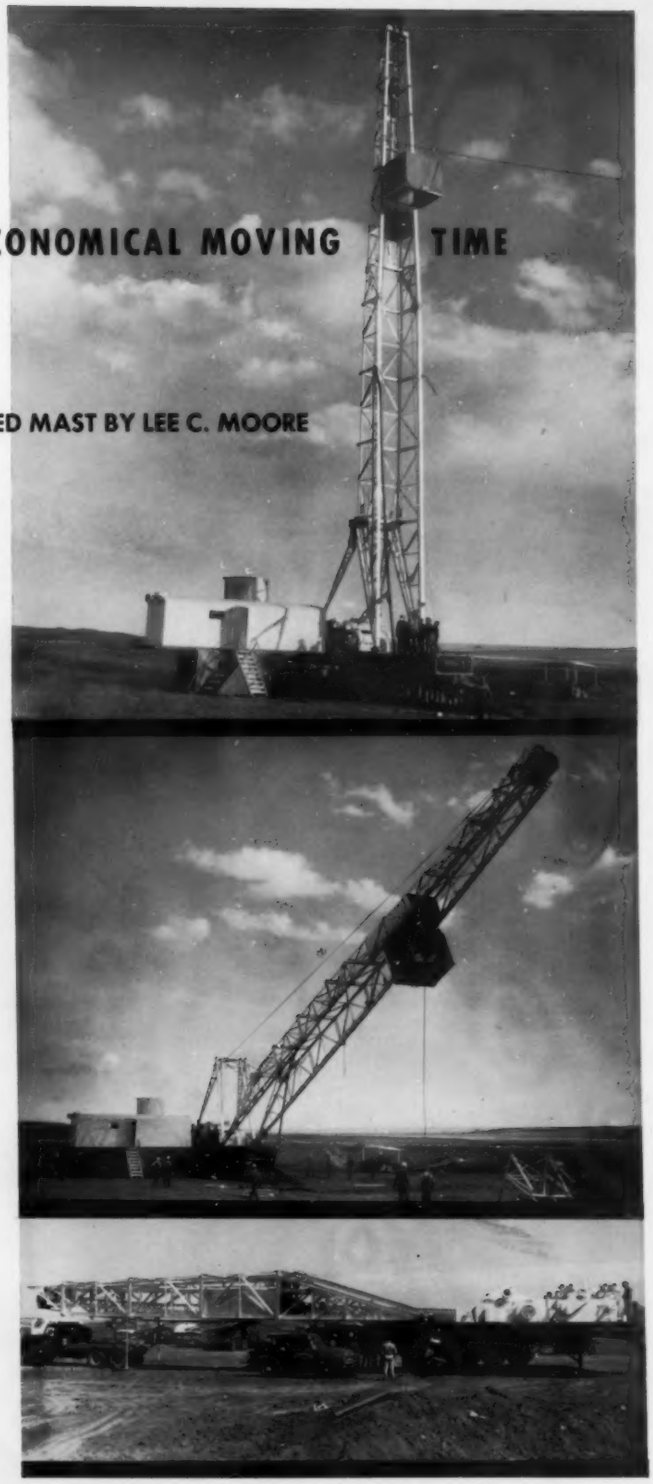

- Lee C. Moore announces a new 126-foot dual trailer mounted mast designed and engineered for both normal exploration drilling with standard 4½" drill pipe and exploratory slim hole drilling. This mast offers greatest possible speed and economy in moving.
- Into this rugged mast that requires no guy lines, Lee C. Moore has incorporated features assuring extreme portability and faster rigging up and tearing down.
- Complete mast and accessories with blocks strung, carried on one trailer and complete drawworks and power and compound carried on the other.
- FOR SAFETY mast is extended and retracted when in horizontal position.
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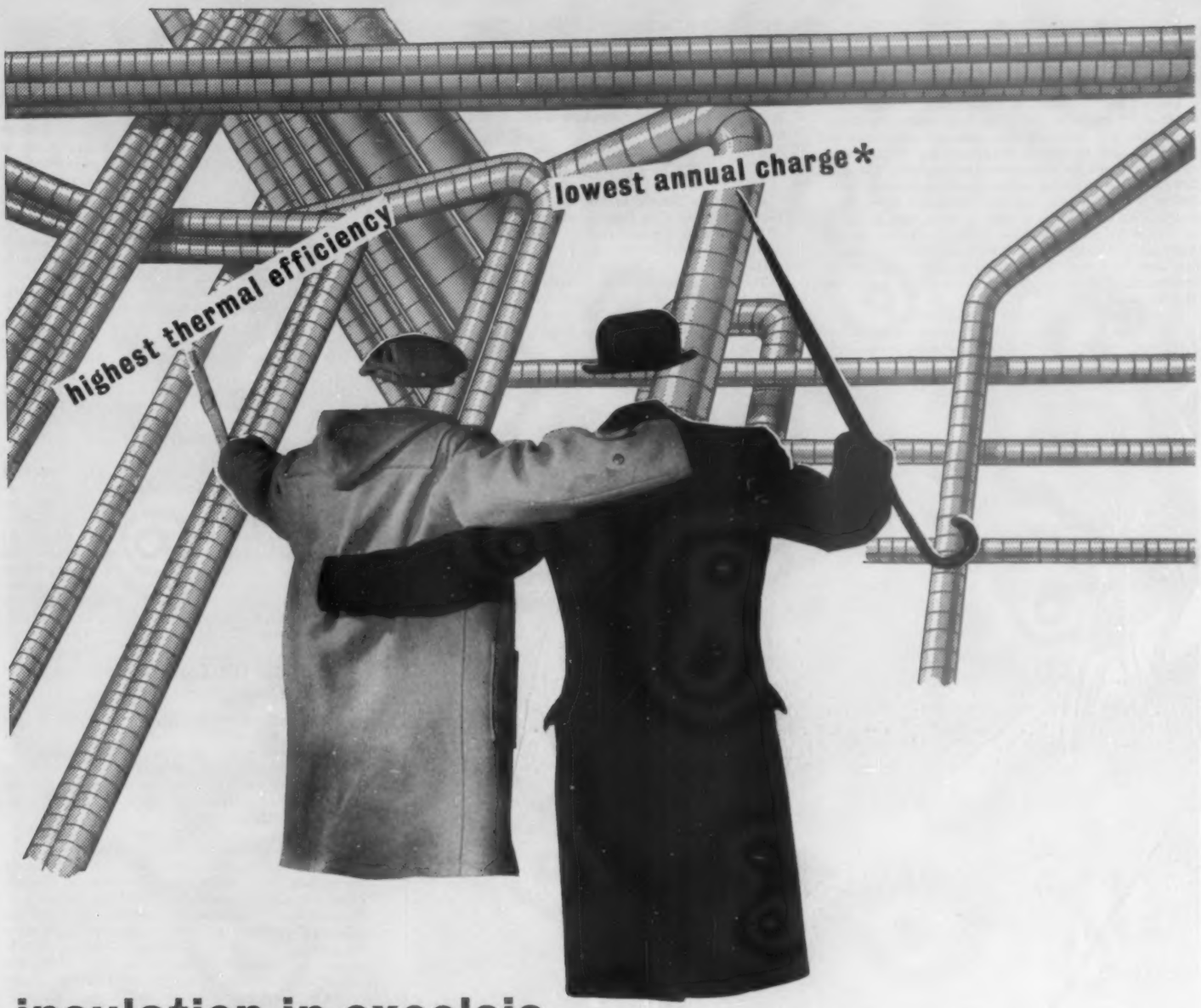

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New Catu Candeias Pipeline Inaugurated

The six inch pipeline, 32.4 miles long, inaugurated on May 10, starts at the Catu field, traverses those of Pojuca and Mata de Sao Joao and continues to Candeias and Mataripe. It crosses the Pojuca and Jacuipe Rivers on suspension bridges with 150 and 292 ft. spans; 40 tanks, with capacities ranging from 250 to 20,000 barrels, are located at the three new fields. The oil will be stored at Mata and pumped to Candeias and Mataripe refinery. Owing to its high paraffin content it will be heated before pumping and in transit from Mata to Candeias. Three intermediate heating stations have been built for the purpose.

Crude production, which totalled 992,409 barrels in 1954 and 2,021,900 in 1955, is expected to reach 5,000,000 in 1956, when the new fields are producing.

Mosul Oil Strike

Mosul Oil Co., member of the I.P.C. group, has struck oil of excellent gravity at 5,000 feet in northern Iraq. Previous exploration work in Mosul has been disappointing.

UCH Field Enlarged

A gas field nearly as big as the one at Sui, has been proved at Uch Bugti, Anticine Marri territory of Baluchistan. Korocki reports state the gas is much more contaminated with impurities and is of a lower calorific value than Sui gas, but still acceptable.

The drilling by Pakistan Petroleum Ltd. for oil in Uch began last year. A significant gas show was found at a 4,000 feet, but the well was drilled to its target depth of 11,000 feet to test for oil. No oil was found.

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McCarthy Plans Gas Line to Chile

Glenn H. McCarthy, president of Glenn McCarthy, Inc., has announced that he has completed negotiations and signed a 20-year contract (with options for 15 more) with Anglo-Lautoro Nitrate Corp., a Guggenheim subsidiary, to supply up to 8,000 billion BTU's of natural gas per year from his Bolivian oil and gas fields.

Mexican Pipe Line Extended

The pipe line Petroleos Mexicanos is constructing from Monterrey to Torreon, which will supply the Laguna agricultural belt with fuel from Tampico, probably will be extended to Chihuahua City, according to spokesmen within Petroleos Mexicanos. They pointed out such an extension would enable the government oil agency to distribute fuel to border cities now dependent upon American imports.

The same sources added a branch pipe line will be built from Estacion Rosillo to Mante, Tamaulipas, with the object of utilizing the latter city as a supply point for Valles, San Luis Potosi and Tamazunchale.

Another phase of this program is amplification of the trans-Isthmus pipeline from the Minatitlan refinery to Salina Cruz, distribution center for the Pacific Coast. Completion of this project will mean a substantial reduction in the importation of refined products, the spokesmen said, although Tijuana and Mexicali will continue to be fed from the United States because of their distance from Mexican refineries. Neither will the plan affect the importation of fuel oil, which cannot be handled by the Tehuantepec pipe line.

Special Oil Tour at Mexican Geological Congress

Oil men attending the International Geological Congress Sept. 4 to 11, in Mexico City will have an opportunity to study the submarine geology of Mexico's West Coast as well as ta visit Petroleos Mexicanos' modern refinery at Salamanca during two special excursions being arranged by the congress' organizing committee.

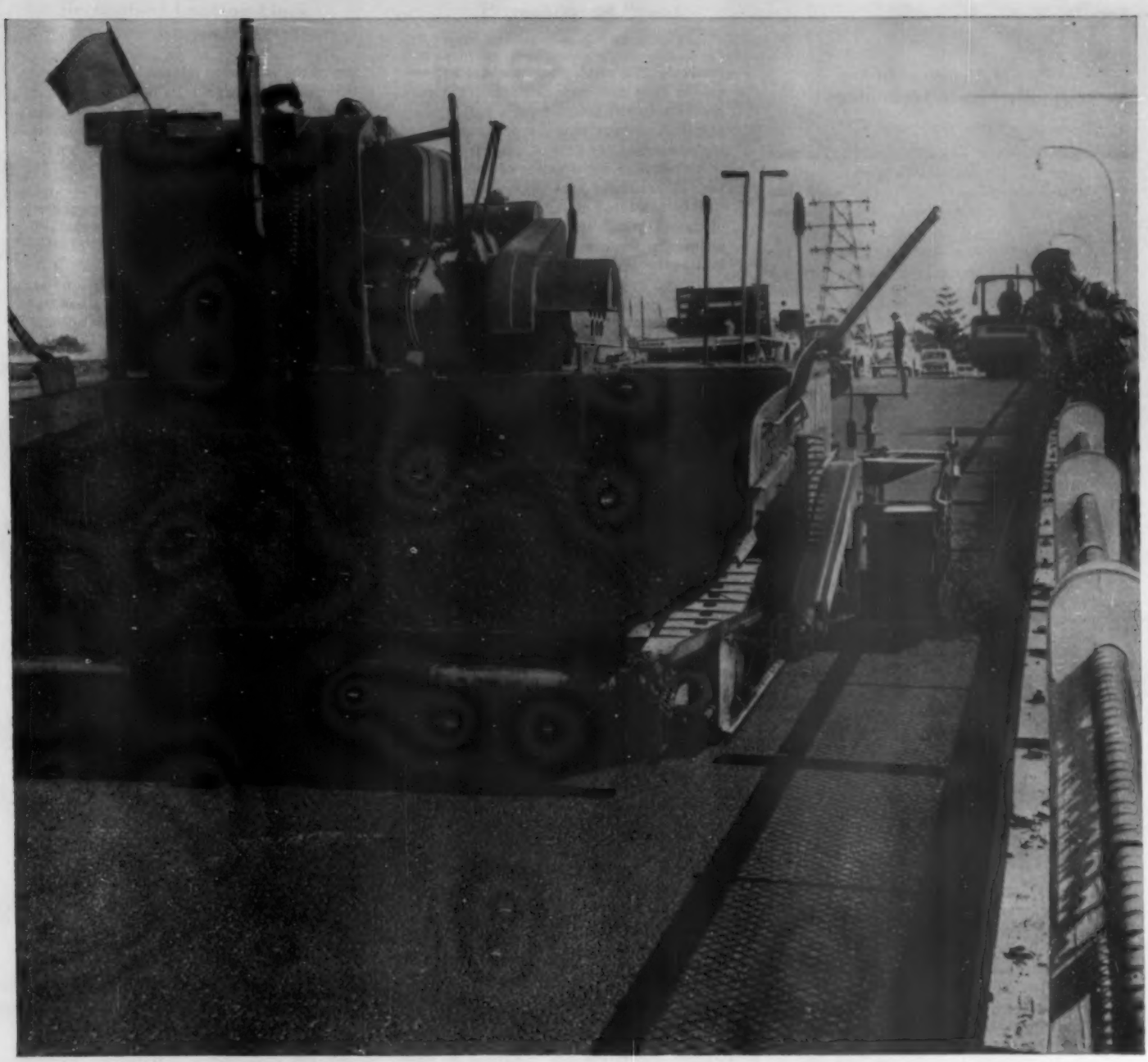
The refinery visit will form part of a tour of historic mines in the picturesque resort city of Guanajuato. The marine excursion is being planned in cooperation with the Scripps Institute of Oceanography of the University of California, which will furnish a boat, the "Baird," especially equipped for such studies. There will be two sailings—both after the petroleum sessions in Mexico City—along the submarine depression known as the "Acapulco Trench" off the coast of the State of Guerrero. These cruises will last four days and will include demonstrations of the latest methods of underwater exploration by geologists, a seismologist and an engineer specializing in this field.

Russia-Latin American Relations

Russia will attempt to establish "very extensive relations" with the petroleum industries of Latin America, Marshal Nikolai Bulganin informed a Mexican newspaper correspondent during an hour-and- a-half interview in the Kremlin in June.

"In the case of Latin America, we should have very extensive relations in the fields of petroleum, mining and electric power." Bulganin's statements put an official seal of approval upon the recent offer of Alexey D. Mayevsky, attache of the USSR's Embassy in Mexico City, to sell Mexico refined petroleum products and equipment used by the Mexican oil industry in return for coffee, sugar and preserved fruits. Since Russia has no commercial agreement with Mexico, Mayevsky suggested one of the best ways to boost trade between the two countries would be for Mexican business leaders to visit Russia.

Those accepting the invitation, he said, will encounter "absolutely no difficulty," can travel "without restrictions" and will be extended "every kind of facility and orientation." But he added such visitors will be divided into one of four categories: "super or supreme," first, second and third classes. For those who might be surprised at this action on the part of a "classless society," the attache explained the classification is "based upon the quality of the persons—that is, their economic possibilities."



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Progress in Reservoir Technology

(*Continued from page 67*)

them. However, in many instances the pore space will be confined to certain portions of the rock mass, resulting in rather low over-all percentage porosity, yet high permeability.

Porosity of Reservoir Rocks. One of the essential characteristics of a reservoir rock is that it must have pore space in which fluids may be stored. We commonly express the porosity of a rock as "percentage porosity," by which is meant the ratio of the volume of the total pore space to the total bulk volume of the rock; but it is apparent that percentage porosity does not fully express the character of the porosity in so far as storage and production of oil and gas are concerned. The pore spaces must be of a size that will permit fluids to pass through them and they must have continuity to permit flow through the rock to recovery wells. Some of the pore spaces in the reservoir rock may be isolated from others so that oil and gas may not pass through them. Thus, for oil recovery purposes, we must distinguish between total porosity and what is called "effective porosity," the latter being that part of the pore space which does possess sufficient continuity for fluids to move through them. Both total and effective porosity are expressed as a percentage of the bulk volume of the rock, and it is usual to find that the effective porosity is a few percent less than the total porosity.[8]

The pore spaces of a reservoir rock present an infinite variety of shapes, whether the rock be a sandstone or a limestone. In the case of limestone, they may be tubular in form, or sheet-like where they are formed by crystalline joint planes or fractures. Or, solution cavities may be spherical or elliptical in form. When they are a result of solution of organic fossil remains, the cavities often assume the form of a cast of the original fossil. In the case of sands and sandstones, the form and size of the pore spaces between grains will be determined primarily by the form and size of the sand grains, whether rounded, angular or subangular. Where tabular faces of angular grains rest against each other, a very narrow space of nearly uniform thickness is left between. Two or more such surfaces meeting along a line of contact form acute-angled recesses. Rounded grains may leave pore spaces that are pyramidal in form between grains. The channels of communication between pores are usually slender constrictions that tend to make of each pore an almost separate rock-walled cell. These constrictions between pores play an important role in developing capillary effects and in controlling the flow of fluids through the rock pores. The primary pore spaces may be greatly altered in form by deposition of secondary minerals in the smaller recesses, and the smooth crystalline faces of sand grains may be roughened by deposition of drusy coatings of secondary minerals. The sand grains are heterogeneous in both size and shape and the pore spaces between grains form a highly variable and complex network of communicating openings.[4]

A well may log a series of strata many feet in thickness that appear to be uniformly saturated with oil, but inspection of cores taken in the course of drilling will ordinarily show that the different strata that make up the reservoir display great variations in percentage porosity and in the size of the pore openings. Some of the component strata may have large and continuous pore spaces and a high percentage porosity that promise substantial oil recovery. Others may be composed of fine-grained materials that have fair percentage porosity, but the pores are so small that production from them is questionable. Because of these variations, it is often difficult to estimate what portion of the reservoir will actually yield oil to the wells under the pressure conditions existing.

The character of the pore spaces varies not only as between different component reservoir strata, but there are also important lateral variations from point to point in the same stratum. Thus, one well may log a particular stratum as one of high porosity with good drainage characteristics, while the same stratum in another near-by well will have much lower percentage poin clay content and degree of cementation rosity and smaller pore spaces. Variations with secondary minerals may develop important changes in the character of the porosity in the same stratum within short lateral distances.

Technologists have developed laboratory techniques for determining the percentage porosity of rock samples that yield reproducible results and are apparently accurate within a fraction of one per cent. It is now common practice to take cores of reservoir rocks in well drilling and subject the cores to laboratory tests to determine their percentage porosity. Many hundreds of such tests may be made on core samples from a single well in an effort to determine an average value for the particular well location, and to disclose variations in porosity of the strata composing the reservoir.[6] In such work, it must be recognized that the core samples on which the tests are made may not be truly representative of the formations from which they come. It is unfortunately true that the methods presently available for taking core samples frequently alter the rock structure and leave the pore spaces contaminated with clay. Coring operations seldom achieve 100 per cent core recovery and the missing portions of a cored interval may be very important in securing a true picture of the reservoir conditions. The more porous and less well cemented portions of a reservoir rock are often disintegrated and lost in the process of coring and are therefore not reflected in the results of laboratory analysis of the resulting cores.[9]

Permeability of Reservoir Rocks. The permeability of a reservoir rock is a measure of the resistance offered by it to movement of fluids through its pore spaces, and is inversely proportional to the flow resistance offered. High permeability in a rock specimen results from a large number of pore openings, of large size, affording continuous channels for movement of fluids. The permeability of a rock specimen is a unique property of the rock structure that is theoretically independent of the character of the fluid moving through it if allowance is made for the viscosity of the fluid. Therefore, it is proper to consider permeability as a function of the reservoir itself, even though in its applications it is concerned primarily with the reservoir fluids and their behavior in the process of drainage, which topics will be in the second and third articles of this series.[3]

An American Petroleum Institute Committee has adopted the "darcy" as the unit of permeability, and A.P.I. Code 27 recommends a standard procedure for measuring and calculating the permeability of rock specimens.[1] The name "darcy" is derived from certain classic experiments conducted by Henry D'Arcy, a French physicist, who in 1856, proposed an empirical formula which expresses the relationships existing between the factors that determine the pressure loss in flow of fluids through porous media.

In making a permeability test under laboratory conditions, a fluid is forced under pressure through a prepared core sample of the reservoir rock while supported in an apparatus which provides a means of measuring the differential pressure employed and the volume of fluid forced through the test specimen in a measured time interval. A rock specimen has a permeability of one darcy when the rate of flow through it, measured in milliliters per second per square centimeter of cross-sectional area, of a fluid of one centipoise viscosity, under a pressure gradient of one atmosphere (760 mm. Hg) per centimeter, is unity. Conditions of viscous flow are assumed.[10]

The fluid employed is generally air or water, and it has been assumed that the calculated permeability will be the same irrespective of the character of the fluid used. However, investigations have shown that this assumption is only approximately true and that laboratory tests using a gas (such as air) as the flow medium may not be entirely dependable when applied to an oil reservoir where liquids (oil or water) are the fluids in motion.[12] However, the difference is slight and in view of other uncertainties involved in such tests, may usually be ignored.

For convenience, a sub-unit, the "millidarcy" (0.001 darcy) is generally employed in reporting rock permeabilities. Actual tests of many thousands of reservoir rock samples have indicated that their permeability, as measured by the suggested procedure, may vary widely. Some recorded permeabilities are as low as 0.5 millidarcy, some as high as 3,400 millidarcys.[2]

(*Continued on page 93*)

Mechanized Loading Lines Feature New Richfield Terminal

(*Continued from page 59*)

The saving in tanker turn-around time is perhaps the most important point stressed by enthusiastic Chiksan engineers who say that the marine loading arm is the first basic improvement in the handling of petroleum products on marine operations in the past 30 years or more. These hydraulically controlled self-powered units enable one man at a remote station to place the flanged end of an aluminum pipe aboard a tanker ready for bolting by the ship's crew in less than five minutes, and return the arm to its position on the dock in even shorter time.

In testing a single unit by Gulf Oil Co. in Philadelphia, it required seven men 25 minutes to make a single 8-inch hose hook-up. The Chiksan arm was hooked up in seven minutes by three men; one at the control point and two to make up the flanges.

Larger loading lines are being designed by Chiksan for other installations. Creole Petroleum Corp. will use four 12-inch and one 8-inch loading lines in four 5-arm units on its new dock on Lake Maracaibo to speed loading of crude oil into supertankers. Even larger capacity lines are being designed. END

New Laboratories Sections

Four new sections have been established in the Tulsa research laboratories of D-X Sunray Oil Co.

R. W. Provine, previously chief chemist, has been promoted to director of the chemical research section; C. Prather, formerly head of the anti-knock laboratory, has been promoted to director of the quality control section; V. L. Brant, chemical engineer, has been promoted to director of the chemical engineering section; and J. V. Lawson, formerly head of the product and process group, has been promoted to director of the technical sales service section.

L. W. Thompson is manager of the company's research and technical service division.

Petrochemical Patent

A recent Australian patent issued to the Phillips Petroleum Co. gives details on the process to polymerize ethylene, propylene, diolefins, etc. It is specification number 6365/55 and consists of 85 pages of text and six drawings, a total of 91 pages of data and process conditions.

It is for the polymerization of mono-olefins and di-olefins over a bed of chromium oxide-silica-alumina with conversions of 100% in the case of ethylene down to 16% for 1-dodecene, much smaller conversions to lower degrees of polymerization for 2-olefins.

Details of the catalyst support are given in extensive tables, as well as the pretreatment of catalyst to change the molecular weight. The best temperature for polypropylene is 190°F. The minimum pressure is 100 psi, and preferably 500 psi. The problems of plugging the catalyst with high polymer and the regeneration of catalyst are indicated. Copolymers give rise to flexible materials.

Patent #6365/55 contains 29 examples, numerous tables of properties of catalysts, products and operating conditions. The polyethylene produced is of high molecular weight, high melting point, high density.

There are 50 process claims, nine product claims, four catalyst claims, three copolymer claims and five various claims (total 71 claims).

Photostatic copies of the 91-page patent can be obtained for $85 from Chemonomics, Inc., 270 Park Ave., New York 17, N. Y.

Sinclair Sells Westpan

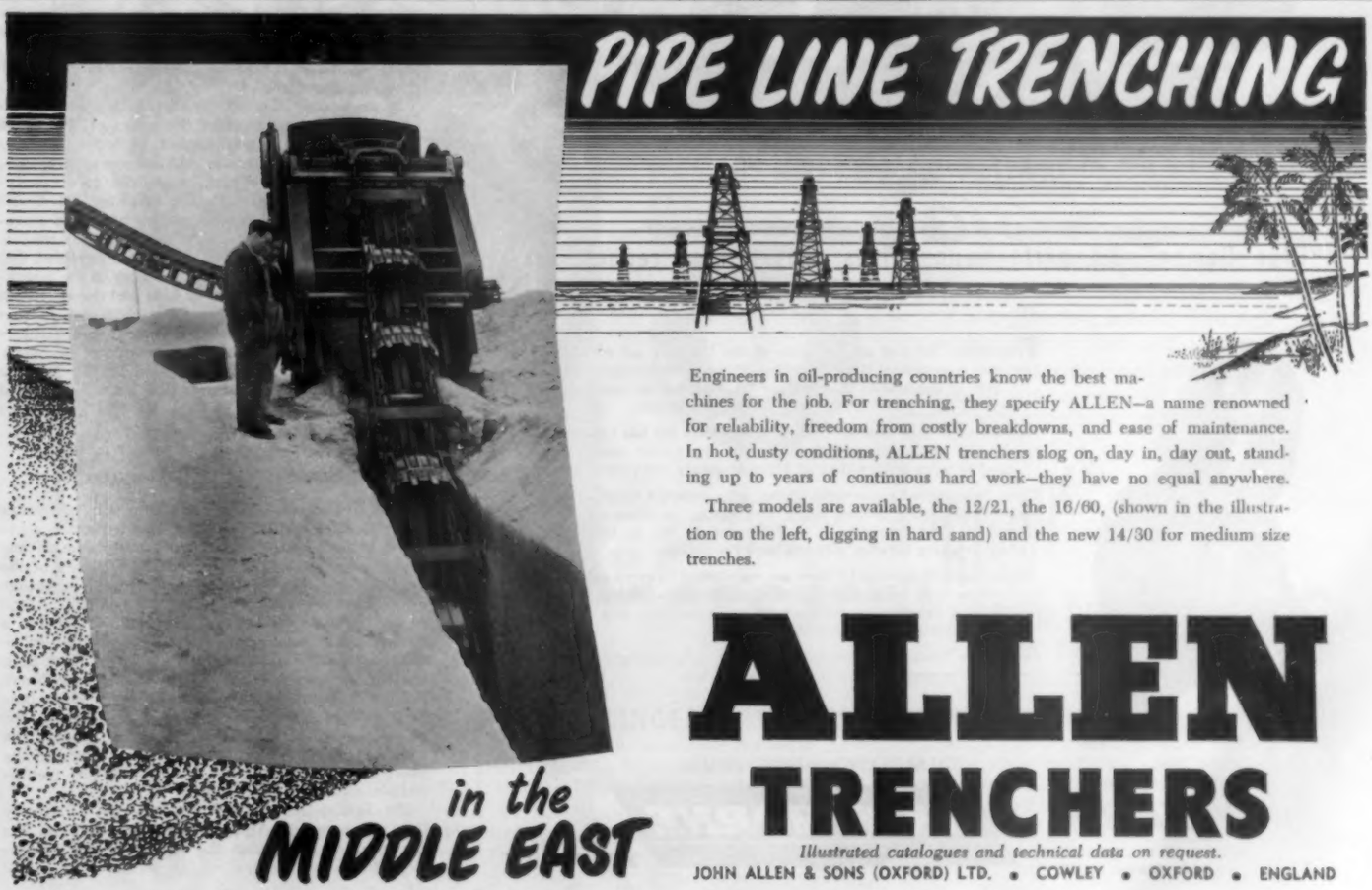
Sinclair Oil Corp. has completed the sale of its 53% holdings (384,861 shares) of Westpan Hydrocarbon Co. common stock to Jalco, Inc., of Dallas. Sinclair received $12.70 a share, or in excess of $4.8 million, for its holdings. Under the terms of a Securities and Exchange Commission order, based on the Public Utility Holding Company Act, Sinclair was required to dispose of all its Westpan holdings.

Shown above are two Klingermatic air-operated valves being used in a refinery gas bottling plant. The valves are ideally suited for remote control of filling lines and as emergency valves requiring rapid operation, as shown above.

Private-Government Company In India

Proposals for a concern to produce and refine 20,000 b/d from Nahorkatiya field in Assam are expected. The Indian Government and Assam Oil Co. may create a company to explore and exploit 402 square miles of field by the Assam Oil Co. in four separate concessions.

Under the terms of two of these concessions, covering 160 square miles in Moran and 280 square miles in Hagrijan, a rupee company may be formed jointly by the Government and the A.O.C. by early April with the Government contributing up to 33.1/3% of capital.



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Hughes to Develop Special Bits for Turbo Drilling

Hughes Tool Co. has concluded a world-wide license agreement with Les Etablissements Neyrpic S. A., Grenoble, France, for the development of special rock bits for turbo drilling. The French company Neyrpic has recently developed, manufactured and field tested turbo-drills in France.

The license of Hughes in Erkelenz, Germany, Alfred Wirth and Co., has been granted an exclusive license pertaining to the manufacture, rental, and servicing of the Neyrpic turbo-drill in Germany, and under special arrangements the right to rent it in certain other countries. Hughes, has been doing special research work on rock bits for new high speed hydraulic drilling for some period of time, but has no plan for the construction of the turbo-drill itself, according to the company.

First Unifining Unit in Germany

The fourth UOP Platforming unit in Germany and the country's first Unifining unit have gone into operation at the refinery of Gewerkschaft Erdol-Raffinerie Daurag-Nerag in Hannover.

Erratum

In the article by Philip L. McLaughlin of Cardwell Manufacturing Co. on page 38 of the July number of WORLD PETROLEUM a typographical error was made in reporting the percentage of drilling to total exploration cost. The correct figure should be 61.9% not 6.9% as printed.

Rise In United Kingdom Fuel Demand

Fuel oil demand is estimated to increase by about 23% yearly over the next five years, according to estimates by a spokesman of the British Fuel and Power Industry. In an address before a government board, the fuel expert predicted that Britain will be using about 21 million tons (about 420,000 b/d) of fuel oil yearly. Present consumption is about 155,000 b/d yearly. To meet the estimated increase would cause considerable expansion in Britain's tanker fleet and refining capacity.

Roland Edwards Hales

Oil Man Receives C.B.E. Award

Roland Edwards Hales, 52 years old of the Shell Group's British Malayan Petroleum Co. at Seria, State of Brunei, British Borneo, was awarded a C.B.E. (Commander in The Most Excellent Order of the British Empire) for public work in Borneo in H.M. Queen Elizabeth's 1956 Birthday Honors List, published on May 31.

World Tanker Fleet Exceeds 41 Million Tons

(*Continued from page* 41)

in an emergency. It comprises an arm fixed to a bollard by brackets which engages with an eye in the shore end of the wire, and a retaining device in the form of a 'U' shaped member one end of which is pivoted to the securing means, which engages over the arm. Quick release of the mooring is obtained by removing a securing pin and knocking the 'U' shaped retaining member off the arm with a sledge hammer. The arm then swivels downwards releasing the wire.

In an earlier article* mention was made of the experimental treatment of the tanks of the "Shell Welder," a small coastal tanker, in order to determine the value of certain anti-corrosion processes. Two of these tanks, which in addition to oil carrying were used as ballast tanks, had been fitted with the "Guardion" three-stage system of cathodic protection. These tanks have since been examined at monthly intervals and close inspection revealed that there was little or no corrosion owing to the formation of an alkaline protective film and the corrosion pattern on the anodes was of such a nature that there was no risk of them collapsing prematurely and giving rise to possible secondary reactions. Tanks 1 and 4 which are only used for oil, show no signs of corrosion, but there is a little cracking of the Epikote resin paint in Tank No. 1. END

*World Petroleum, July 1955 page 37.

Sea Survey Off Borneo

The British Malayan Petroleum Co., Sarawak Oilfields, Ltd. and Shell Co. of North Borneo combined in mid-March to resume gravity and seismic survey of a large area of the inshore waters of the South China Sea, off the British Borneo coastline. Four survey vessels are being used—shooting and recording ships for seismic, a gravity vessel and a fourth craft equipped with a recording echo-sounder. Radio direction-finding stations have been set up at three points along the Brunei-North Borneo coastline to correlate operations. More limited programs have been carried out during the non-Monsoon periods of the past two years. The vessels engaged in the present effort include the Shell Group's "Prospector," sent with her technicians for the task from Qatar.

The British Navy planned to use the oil survey R.F.D. network in April to bring South China Sea charts up to datee, and the survey frigate, "Dampier," has been assigned to this work.

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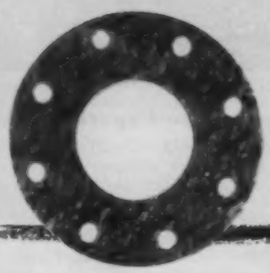

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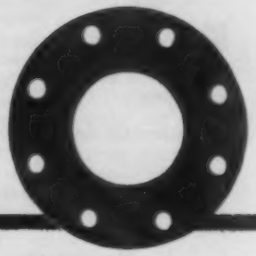

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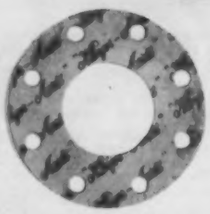

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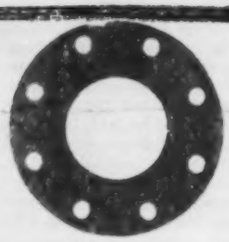

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International News and Notes

Assam Oil versus the Government

Negotiations have been re-started between the Government of India and the Assam Oil Co., for the formation of a rupee company for the joint exploitation of recent oil finds in Assam. At last meeting of the parties, the government asked 51% share in the proposed company and the company's representatives sought adjournment of discussions. The Assam Oil Co. was granted a mining lease in 1954 for about half a square mile in Naharkatiya for a period of 30 years. Subsequently, it was given a prospecting license for three years for 64 square miles in the Naharkatiya extension area on condition that it would form a rupee company with 25% Indian capital. Indian share: When the company was granted a prospecting license for two new areas in Assam last year the government stipulated the condition that Indian capital would amount to 33½%. Now that the company is asking for rights in other areas, the government of India has raised its share to 51%.

In the impending negotiations the company, it appears will have a choice between retaining its rights over areas already leased to it, should it adhere to the 33½% condition, and accepting the government's new demand for 51% on the basis of a larger area and possibly a longer lease.

Iraq Runs to Stills

By plants, here are the figures on runs to stills in refineries in Iraq, as reported to U. S. officials:

Baghdad, Iraq

Iraq—Crude Runs to Stills, 1955

Daura Refinery, 397,878 long ton (7,958 b/d); Alwand Refinery, 427,811 long ton (8,556 b/d); Muftia Refinery, 206,280 long ton (4,126 b/d); IPC Kirkuk topping plant, not available; Qaiyarah bitimen refinery, 13,770 long ton (275 b/d).

Another Natural Gas Line in Pakistan

Pakistan Constructors, a joint venture of D. & C. & Wm. Press, Ltd. of London and Morrison-Knudson International Corp., Inc., of San Francisco have signed a contract with Pakistan Industrial Development Corp. for the building of a 212 mile natural gas pipe line in West Pakistan running from the Sui Gas Field in Baluchistan to Multan in the Punjab. Work on the line is due to start at the end of this year. The same organization recently built a 350 mile gas pipe line from Sui to Karachi in record time. The new line will be built in 16 inch pipe, with a wall thickness of 5/16 inch, the same size pipe as was laid from Sui to Karachi, but in this case 50% of the pipe is being made by Stewards & Lloyds and 50% by Dalmine of Italy. Stewards & Lloyds supplied the whole of the pipe for the previous line.

The line will run in an easterly direction from Sui until it crosses the River Indus at Kashmor, then will go along the Indus for some length, after that across the River Sutlej and on into Multan. Later on the line may be extended a further distance of about 200 miles to Lahore. The estimated cost of the Sui-Multan section is about £2 million ($5.6 million).

Australia's First Petrochemical Plant

Work has begun on a £2 million $5.6 million) project for the manufacture of carbon black from special petroleum fractions at Geelong, Victoria, in Australia. The plant, which is designed to produce 16,000 tons, will be built and owned jointly by Union Carbon Co. of Charleston, West Virginia and Shell Petroleum Co. Ltd.

Sidon Deliveries Up Slightly

Fourth quarter, 1955, pipe line receipts were 483,001 b/d in the fourth quarter of 1955, compared with 479,039 b/d in the fourth quarter a year earlier.

The receipts were 159,537 b/d at Tripoli, and 323,464 b/d at Sidon. Iraq Petroleum Co. line delivers to Tripoli, and Trans-Arabian Pipe Line to Sidon.

Deliveries to refineries and ships came to 489,311 b/d in the fourth quarter of 1955, compared with 499,032 b/d in the fourth quarter a year earlier. The deliveries were to Tripoli 165,846 and Sidon 323,465.

Iranian Exports & Refining

Exports of crude oil and refined products by NIOC and Consortium member companies and Abadan refinery production, are given below:

Exports of Crude and Refined Products
(Bbls.)

January	*Crude*	*Ref. Products*
NIOC	830,503	N. Available*
Consortium	5,332,756	3,090,062
	6,163,259	3,090,062
February		
NIOC	595,478	N. Available*
Consortium	4,959,985	3,861,317
	5,555,463	3,811,317

*Not significant

OIL TAKE OF REFUND PRODUCTS BY CONSORTIUM MEMBER COMPANIES AND BY NIOC
(BBLS.)

Jan.	*Avgas*	*Motor Fuel*	*Kerosine*	*Vaporizing Oil*	*Distillate Gas oil*	*Diesel*
NIOC	12,319	137,157	318,610	1,908	132,938	8,610
Member Co.	107,292	569,503	194,199	54,942	255,017	362,212
	119,611	706,660	512,849	56,850	387,955	370,822
Feb.						
NIOC	12,324	177,320	326,185	1,907	133,142	7,900
	64,173	743,688	524,386	166,829	454,079	300,641
	76,497	920,990	850,571	168,736	587,221	308,541
	IRANIAN EXPORTS & REFINING					
NIOC	20,323	3,832	14,591	770		651,098
Member Co.	1,424,789	NIL	94,627	27,481		3,090,062
	1,445,112	3,832	109,218	28,269		3,741,160
Feb.						
NIOC	22,429	4,433	22,415	1,343		709,380
	1,446,210	NIL	72,234	89,077		3,861,317
	1,468,639	4,433	94,649	90,420		4,570,697

*NOTE:—Totals for Jan. and Feb. include: Avgas, Motor Fuel, Kerosine, Vaporizing Oil and Distillate.

New Oil Facilities in Tanganyika

An oil jetty in Dar es Salaam harbor is to be constructed under an agreement between oil companies in the country and the East African Railways and Harbours Administration. The present floating pipe line carrying oil from tankers to the shore is regarded as "unsatisfactory and dangerous".

The new jetty is to be 2,500 feet beyond the present dhow wharf and 4,000 feet beyond the new deep water berths. The cost is to be $462,000, to be paid for by EARHA. Oil companies are to install the pipe line jointly connecting the oil head with the present distribution point near storage tanks.

The jetty is to have a T shape, with the stem 530 feet and the head 200 feet. An access road eight feet wide is to be laid. It will be so located to unload vessels of 32,000 tons and 35 feet of draft.

The new jetty will help supply growing consumption needs in Tanganyika, which have risen to about 3,818 b/d during 1955. Consumption breakdown is given in imperial gallons as follows:

Retained Imports (net imports less re: Exports)

	1954	*1955*
	(*Thousands of Imperial Gallons*)	
Gasoline		
Aviation gasoline	1,118	1,032
Motor gasoline	15,983	16,262
Kerosine		
Power kerosine	503	428
Lamp oil	4,412	6,366
Gas oil, diesel oil	15,782	24,693
& other fuel oil	37,798,000	48,781,000
	(2,959 b/d)	(3,818 b/d)

Bunkers took 1,749 tons (35 b/d) in 1955, with port facilities available for small craft.

Shell Oil Co. handles all the aviation gasoine in the country; California Texas Oil Co. handles the fuel oil sales to the raiways.

Tankers for Esso Standard

Esso Standard Oil Co., the French affiliate company of S.O.C. (New Jersey) announces that it will order 10 supertankers of 38,000 dwt each over the next ten years.

Development Expenditure in Iraq

The Iraq Development Board has increased its estimate of expenditure for the period 1955-60, from £448 ($1,254.4) million to £500 ($1,400) million, which has been passed by the Iraqi Chamber of Deputies. It is estimated that Iraq's income from oil earnings will reach £464 ($1,299.2) million during the next 5 years, and that it will be £80 ($224) million for 1956.

Test Well On Zanzibar Island

The BP-Shell Petroleum Development Co. of Tanganyika has started drilling a deep well on Zanzibar Island as part of a test program to examine the possibilities of oil on this section of the African Coast. Test may be drilled to 12,000 feet.

The British Petroleum Co., in association with the Royal Dutch-Shell Group, has been carrying out intensive oil exploration, including geological and geophysical surveys, over wide areas of East Africa since 1951. The Zanzibar well is the second deep test well to be drilled. The first, on Mafia Island, off the coast of Tanganyika, was completed early this year at 11,051 feet and yielded valuable geological information.

Oil Search in Pakistan

An agreement was signed in Karachi on May 26, 1956 between the government of Pakistan and the Shell Co. of Pakistan under which an operating company, Pakistan Shell Oil Co. Ltd., will be formed to carry out an extensive search for oil over an area of some 10,000 square miles in West Pakistan and an area of similar size in East Pakistan.

Petroleum Development of Pakistan Ltd., a company to be wholly owned by Pakistan private capital, will hold 25% of the shares and Shell the remaining 75%. If oil is produced in commercial quantities, profits will be shared equally with the government of Pakistan. The first deep test is expected toward the end of 1857.

A test well near to Karachi is shortly to be commenced by the Burmah group of companies. At Sylhet, Assem the second test well was spudded in on May 24th. The first test well at Sylhet caught fire some little time ago and all the equipment was burned out. New equipment has been obtained by the Assam Oil Co. for drilling this second well.

Germany

Capacity of the Deutsche Shell refinery at Hamburg will be increased from 900,000 tons per year (18,000 b/d) to 2.5 million tons per year (50,000 b/d). A platformer was put on stream in March of this year and is not included in the present program of extensions, which will include an atmospheric distillation plant with a capacity of 1.6 million tons per year (32,000 b/d), vacuum distillation plant, a fluid catalytic cracker, a further platformer unit, to deal with the straight run naphtha from the atmospheric distillation unit, and a hydrodesulfurization unit. The extensions are scheduled for completion at the end of 1958.

Tapline Capacity Up

The capacity of the Trans-Arabian Pipe Line is to be raised over 20% to 410,000 b/d of crude oil, according to company officials.

The capacity is to be raised by four pump stations costing $14 million, which will add 90,000 b/d to capacity.

Two of the stations will be at midway points between Quaisumah, Rafha and Turaif station will be near Jordan frontier. The fourth will be at the Karyatain, Jordan, area. All will be radio-controlled.

Delivery of equipment is to start in February, 1957, and the stations are to be in operation January, 1958.

New Monopoly Proposed in Brazil

A new petroleum law, to bring distribution of petroleum under the government oil monopoly, has been introduced and set for debate.

Under the 1953 petroleum law, exploration and production were put in government hands, but distribution was left to private companies, largely from the U. S. U. S. officials say sponsors of the new law are "UDN party members, Communist party liners, and those who oppose the administration."

Red China—a Rising Oil Star?

(Continued from page 49)

used for drilling alone. In 1953, 611% more funds were allocated for geological prospecting and, in 1955, 1,160% more than in 1952.

It is reported that several thousand Soviet "consultants," "experts" and scientists as well as some 140 Romanian oil-engineers and master-drillers are stationed in China to train Chinese workers. This is said to be a temporary solution while China is completing her own training program. In 1952, she claimed to have had four times more technically trained oil personnel than in the pre-war period and, in 1954, six times as many.

Following the Soviet example, China established as early as 1949 her own Academy of Sciences which, as an annex of the Planning Board, is actively involved in oil development. Geological activity is directed by the Institute of Petroleum in Peking where oil engineers and geologists have been trained since 1954. The first class of 500 students will graduate in 1957. The students of the Petroleum Faculty of the Tsingtao University as well as those studying at the Dairen Industry Institute's Department of Liquid Fuels (totaling several hundred) were transferred to Peking to continue their studies. During vacations, all students are assigned to practical jobs in the Yumen oil fields. There are five Petroleum "tekhnika," organized after the Soviet model, where oil technicians are being trained. The largest ones are at Tihwa and Chungking.

Specialists with higher education are further trained at the Chinese Academy of Sciences where some 4,000 scientists are working in its 28 research institutes. The 210 Chinese colleges, with an enrollment of 280,000 students, offer a large base for selection of future cadres. Several hundred Chinese students are trained annually at Russian universities, institutes and plants, while an additional number of technicians are trained every year in Romanian institutes and oil fields.

Production: Last December, Peking announced for the first time its 1957 Plan target is absolute figure of 11 million barrels of crude oil. Recently, however, the Government asserted that this as well as other targets must be fulfilled during the current year. Based on percentages for previous years, disclosed by both Peking and Moscow, the crude production picture appears to be as follows:

1949	1,925 b/d
1950	2,600 "
1951	4,400 "
1952	6,360 "
1953	7,950 "
1954	9,870 "
1955	12,800 "
Plan 1957 (or 1956)	20,300 "

Shale Oil: An additional supply source of liquid fuel is derived from the shale of the Manchurian Basin. Its oil reserves amount to 7.6 billion metric tons, of which 5.4 billion tons are found in the Fushun deposit (Fengtien Province). The shale layer here is 230 to 400 feet thick and mined from open pits. The oil content of the Manchurian shale varies between two and 14%. At a conservative average of 5.5%, these deposits may yield up to three billion barrels of shale oil.

According to Japanese and German data, the Manchurian shale processing capacity amounted, at the end of the war, to 17,000 b/d, while the five main oil-from-coal works at Fushun, Fusin, Mukden, Kirin and Szupingkai added a further capacity of 9,600 b/d. Many of these plants were dismantled or damaged by the war. After reported repairs and completions (mostly with Czech and East German assistance), the shale and synthetic oil production may amount, at present, to 14,000 b/d.

Consumption and Supply: China's oil requirements are, comparatively, modest, but none the less essential for running her economy. Motor traffic was cut down to a bare minimum, but industrial activity increased its consumption. Expanding civil aviation, river navigation and particularly, the military machine needed to keep order on this troubled subcontinent with its 500 million peasants, are steadily increasing their fuel demand. Current consumption may, therefore, amount to 100,000 b/d, of which domestic production of crude and shale oil covers only one-third.

China produces an additional quantity of substitute liquid fuels, such as methanol and ethyl alcohol. Small quantities of diesel and lubricating oils are further produced from vegetable oil. However, the substitute fuels add up to a very modest quantity and thus do not greatly alter China's consumption picture.

During the last three years before the coming of Communist rule, China's import needs were estimated at 20 to 25 million barrels/year, but actual imports amounted to between six and 14 million barrels/year. Present import requirements may run to about 25 million barrels/year. Their greater part is covered by Romania and Russia from Black Sea ports through the Suez Canal to the Pacific Coast. Oil is carried in Russian, Romanian, East German, Polish and Czech tankers. A joint Sino-Polish shipping company was established in February 1951 which carries cargo from European shores to China. At present, there are also three Czech ships on the Europe-China supply run.

Despite its proximity, the Sakhalin oil base is only a limited supply source for China as its production is badly needed by Russia's Far East. From Okha and Ekhabi, China gets only small quantities of diesel oil.

More difficult is the oil supply of southern China, which is carried by freighters flying Finnish or South Asian flags. Since the use of the Hong Kong facilities has been denied, China must be using the supply channel afforded by Macao and the neighboring non-Portuguese islands as well as her own and the Red Viet-Namese facilities available in the Gulf of Tonkin.

Planning Features: It may still remain a debatable question, but the logic of available facts seems to refute the conclusion that China's planning was revamped as a result of the embargo on trade in strategic materials. Provisions for the development of northwest China, for instance, were included in the first Sino-Soviet economic agreements of February 1950. The location and nature of the 211 industrial enterprises to be built with Soviet assistance were, apparently, of China's choosing. It is, therefore, likely that Chinese planning was shaped by Chinese motives and ideas rather than by outside influences.

The industrialization program launched in 1953 is officially justified by the "autarky doctrine," the aim of which is to "guarantee China's economic independence in relation to all States," hence not only to the capitalist ones. (Jen Min Jeh Pao editorial of May 22, 1953). Autarky is, therefore, the first feature of Chinese planning.

Its second feature is germane to the first, and may be briefly described as economic development of the country on a regional basis. Red China's planning moved the center of economic interest from the port towns and the east coastal regions to inland areas. The new railways reveal a new economic orientation, namely, that they will assist in developing mineral resources and industries in the interior of China.

In the near future, China will continue to develop her oil sources on a regional basis with a view to creating fuel supply bases for the projected industrial regions. There are many imponderables which contribute uncertainties to Chinese planning such as flow of foreign assistance and the amount of technical help. Of more important consequences are, however, the vagaries of nature and the peasants' resistance which will determine China's success in securing the needed "totalitarian development finance." As long as the investment means are limited, there is little prospect that the oil industry will be developed on a broader basis, to the detriment of the other industrial sectors. END

Mozambique Oil Imports

According to final reports from Lourenco Marques, Mozambique consumption of petroleum products during 1954 was 1,573 b/d, distributed as follows: gasoline, 35,584,000 liters; fuel oils, 35,164,000 liters; kerosine,, 16,571,000 liters; lube oils, 3,899,000 liters; total, 91,298,000 liters (574,245 bbls.).

A shortage of alcohol put a stop to the requirement that 75% of gasoline be mixed with 25% alcohol to produce "alcoolina" as fuel for motor cars in the Beira District.

At that, some 39.2 million liters of gasoline were mixed during the year before the program came to a halt.

C. Eugene Davis

Fifth World Petroleum Congress in New York

New York City will be site of the Fifth World Petroleum Congress. Plans call for the Congress to be held in New York's new Coliseum at Columbus Circle May 30 through June 6, 1959. C. Eugene Davis, petroleum consultant, recently retired vice president of Shell Oil Co., will serve as General Secretary of the Congress.

At the Fourth Congress in Rome last summer, Eger V. Murphree was re-elected chairman of the organization's top governing group, the Permanent Council. Mr. Murphree, president of Esso Research and Engineering Co., is currently on a one-year leave of absence from his firm while serving as special assistant to the Secretary of Defense for Guided Missiles.

A general organizing committee set up to conduct the Fifth Congress consists of: F. S. Clulow, vice president in charge of manufacturing, Shell Oil Co.; H. W. Field, general manager, research and development, Atlantic Refining Co.; Jerry McAfee, vice president, Gulf Oil Co.; John C. Zimmer, assistant manager, Socony-Mobil Laboratories; E. B. McConnell, vice president, Standard Oil Co. (Ohio); H. B. Nichols, vice president and director, California-Texas Oil Co.; J. K. Roberts, general manager, research and development, Standard Oil Co. (Ind.); W. C. Kinsolving, vice president, Sun Pipeline Co., and Mr. Murphree, chairman.

Orders For Tankers

Esso Standard Oil Co., French affiliate of the Standard Oil Co. (N. J.) will order 10 supertankers of 38,000 dwt each between now and 1965.

British Tanker Co. Ltd., owned by British Petroleum Co. Ltd., has placed orders in various British shipyards for nine 14,000-dwt. motor tankers for delivery in 1958-59 at a total estimated cost of $33.6 million.

Beckner Named to Fuel Post

Earl R. Beckner, formerly acting chief, has been named chief of the fuels division, Office of International Trade and Resources, of the U. S. State Dept.

He takes the place of Robert H. S. Eakens, who has moved to Santiago, Chile, as economic counselor after many years as head of the division.

Mr. Beckner, who was born in Indiana in 1895, has had a long government career. He graduated from Butler University and took a master's degree at the University of Chicago. He took his Ph.D degree at the University of Chicago in 1927.

He was in the U. S. Army in 1918.

Mr. Beckner was a professor of business administration at Butler from 1927 to 1939.

He was assistant director of the Farm Security Administration until 1942; an economist with the War Production Board until 1945, and with the Foreign Economic Administration until 1946, when he joined the U. S. State Department, serving in Germany and elsewhere.

In 1954, he became acting chief of the petroleum staff at the department.

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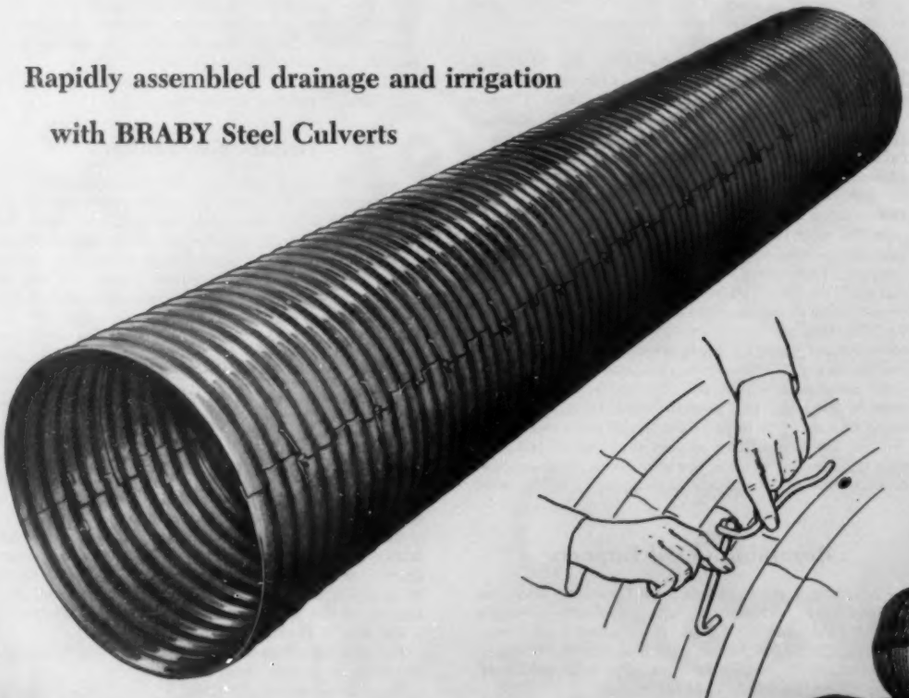

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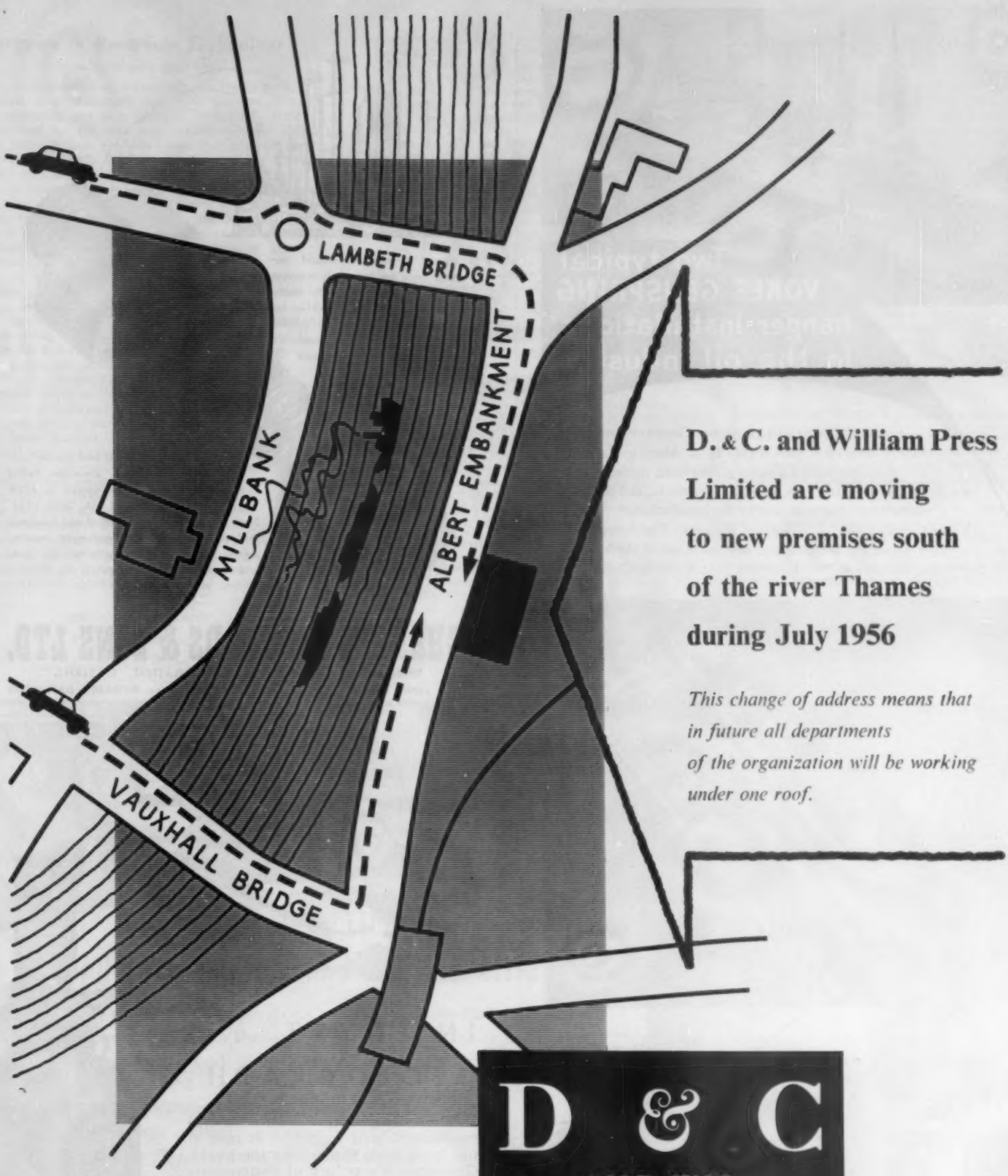

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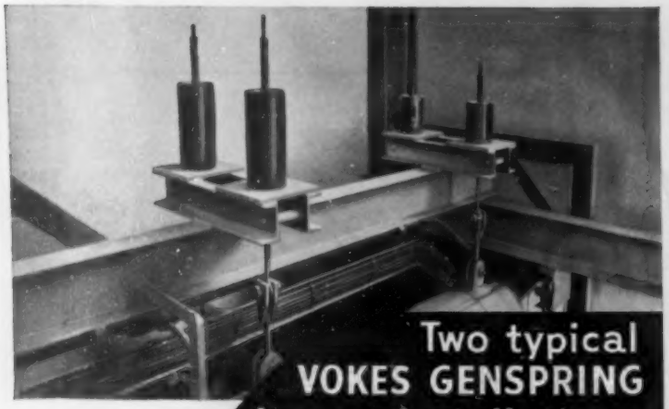
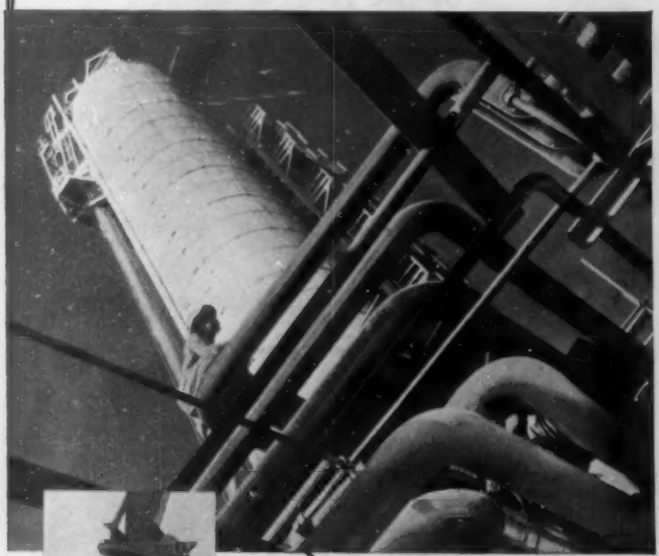


Two typical VOKES GENSPRING hanger installations in the oil industry

Photograph by courtesy of The Associated Ethyl Company Limited.

IN ADEN, The British Petroleum Company's new refinery came on stream in July 1954. Many sections of this complicated process plant piping demand the finest and most accurate suspension methods, and this requirement has been met by the installation of Vokes Genspring Variable Support Hangers. The Associated Ethyl Company Limited have also made use of these Vokes Genspring Hangers at their Ellesmere Port Works in Cheshire.



Photograph by courtesy of The British Petroleum Company Limited.

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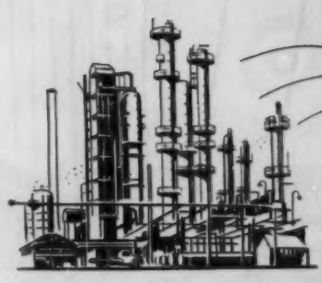

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Progress in Reservoir Technology

(Continued from page 84)

The permeability of a reservoir rock will be influenced to an important degree by the size of its pore openings, and in a granular rock this will be determined by the size and arrangement of the sand grain. Screen analyses show that sand grains vary from as little as 0.05 mm in diameter (300 mesh) to 1.66 mm (10 mesh), and that a typical sand or sandstone is made up of grains varying in size over a wide range. Small grains are occluded within the pore spaces of larger grains. More or less clay is usually also present in the pore spaces and secondary minerals deposited on the mineral grain surfaces tend further to reduce permeability.

As the sand grains are laid down under water in normal processes of sedimentation, the mineral grains tend to assume a certain degree of orientation, resulting in stratification; and it is found that the resulting sandstone formations are much more permeable to fluids moving along the bedding planes than across the bedding planes.

Large Surfaces of Myriad Pore Spaces Exposed by Reservoir Rocks to Contained Fluids. Studies of the structure of reservoir sands and sandstones and the geometry of their pore spaces have emphasized the very large number of pore spaces and the large mineral surfaces exposed to fluids stored in their pore spaces. Computations indicate that a cubic foot of closely compacted unconsolidated sand of average grain size (30 mesh) exposes a surface of something like 2,000 square feet to the contained fluids. And a cubic foot of such sand may contain approximately 200 million pores between its grains. As will be shown in the third article of this series, these factors have an important influence upon the efficiency of drainage that we may hope to achieve.

END

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Saudi Arabian Air Survey

About one-fourth of Saudi Arabia will be mapped from the air to speed the government's natural resources development program. Flying of the 200,000 square mile survey was started recently by Aero Service Corp. The survey covers the Shield Area of Saudi Arabia, which is believed to be potentially rich in minerals. The survey is being paid for wholly by the Saudi Arabian government.

British Petroleum Orders Nine Tankers

The British Petroleum Co.'s shipping subsidiary, the British Tanker Co., has recently placed orders for nine 14,000 ton tankers for delivery in 1958 and 1959. This brings to 41 the total number of tankers now on order or under construction for B.P.

BP's present tanker fleet consists of 144 ships totaling 2,018,000 deadweight tons. In addition, the company has about 2,500,000 deadweight tons of tanker shipping on charter.

New Crane for Offshore Work

A new fixed mounting crane has been designed by Unit Crane and Shovel Corp. of Milwaukee. The unit is designed to meet all requirements for cargo handling from a stationary mounting on offshore platforms of either the mobile or fixed types Usually two cranes are used per platform with one for platform tenders. The Unit Mariner, as it is known, is Diesel powered and rated at 30 tons capacity at a 12 foot radius. Base length of the boom is 45 feet, which can be extended to 75 feet.

Yugoslavia Steps Up Exploration

Yugoslavia has intensified exploration, especially in the province of Croatia. Seven oil fields are presently in operation in Croatia: Gojlo, Mramor-Brdo, Sumecani, Kriz, Klostar Ivanic, Dugo Selo and the oldest Yugoslav oil field, Selnica-Peklenica.

Exploratory drilling is being conducted along the Moslavina mountains and in the territory between the rivers Sava and Drava in the direction from Zagreb toward the east as far as Nova Gradiska.

Drilling is presently being carried out at Resnik, Vrbovac, Dubranec, Osekovo, Navska, Nova Gradiska and Janja Lipa. Sixteen modern rotary drilling rigs, including two American "Cardwell" rigs of 11,483 ft. capacity are in operation.

Geophysical work done in 1955 in these regions is now being continued with seismic parties in operations.

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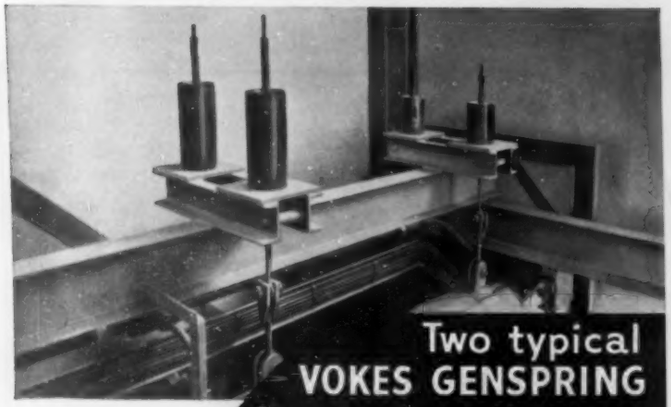
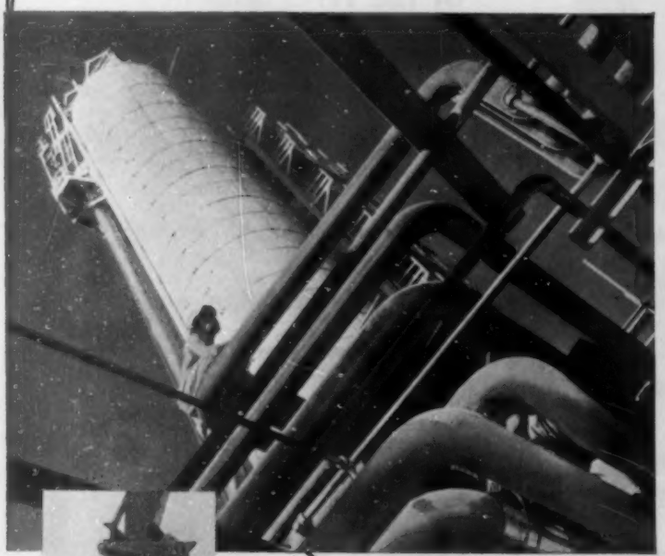


Photograph by courtesy of The Associated Ethyl Company Limited.

Two typical VOKES GENSPRING hanger installations in the oil industry

IN ADEN, The British Petroleum Company's new refinery came on stream in July 1954. Many sections of this complicated process plant piping demand the finest and most accurate suspension methods, and this requirement has been met by the installation of Vokes Genspring Variable Support Hangers. The Associated Ethyl Company Limited have also made use of these Vokes Genspring Hangers at their Ellesmere Port Works in Cheshire.



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VOKES GENSPRING Variable Support Hangers are specifically designed for the control of vibration and limited thermal movement of piping, but where piping systems need to be 'floated' to offset the efforts of extensive movement, Vokes Genspring Constant Support Hangers should be used. The full range is detailed in the Vokes Genspring catalogues available on request.

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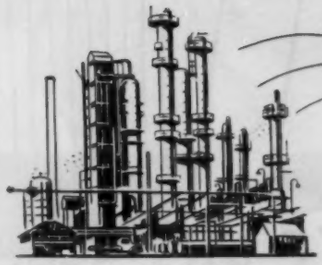

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Progress in Reservoir Technology

(Continued from page 84)

The permeability of a reservoir rock will be influenced to an important degree by the size of its pore openings, and in a granular rock this will be determined by the size and arrangement of the sand grain. Screen analyses show that sand grains vary from as little as 0.05 mm in diameter (300 mesh) to 1.66 mm (10 mesh), and that a typical sand or sandstone is made up of grains varying in size over a wide range. Small grains are occluded within the pore spaces of larger grains. More or less clay is usually also present in the pore spaces and secondary minerals deposited on the mineral grain surfaces tend further to reduce permeability.

As the sand grains are laid down under water in normal processes of sedimentation, the mineral grains tend to assume a certain degree of orientation, resulting in stratification; and it is found that the resulting sandstone formations are much more permeable to fluids moving along the bedding planes than across the bedding planes.

Large Surfaces of Myriad Pore Spaces Exposed by Reservoir Rocks to Contained Fluids. Studies of the structure of reservoir sands and sandstones and the geometry of their pore spaces have emphasized the very large number of pore spaces and the large mineral surfaces exposed to fluids stored in their pore spaces. Computations indicate that a cubic foot of closely compacted unconsolidated sand of average grain size (30 mesh) exposes a surface of something like 2,000 square feet to the contained fluids. And a cubic foot of such sand may contain approximately 200 million pores between its grains. As will be shown in the third article of this series, these factors have an important influence upon the efficiency of drainage that we may hope to achieve.

END

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Saudi Arabian Air Survey

About one-fourth of Saudi Arabia will be mapped from the air to speed the government's natural resources development program. Flying of the 200,000 square mile survey was started recently by Aero Service Corp. The survey covers the Shield Area of Saudi Arabia, which is believed to be potentially rich in minerals. The survey is being paid for wholly by the Saudi Arabian government.

British Petroleum Orders Nine Tankers

The British Petroleum Co.'s shipping subsidiary, the British Tanker Co., has recently placed orders for nine 14,000 ton tankers for delivery in 1958 and 1959. This brings to 41 the total number of tankers now on order or under construction for B.P.

BP's present tanker fleet consists of 144 ships totaling 2,018,000 deadweight tons. In addition, the company has about 2,500,000 deadweight tons of tanker shipping on charter.

New Crane for Offshore Work

A new fixed mounting crane has been designed by Unit Crane and Shovel Corp. of Milwaukee. The unit is designed to meet all requirements for cargo handling from a stationary mounting on offshore platforms of either the mobile or fixed types Usually two cranes are used per platform with one for platform tenders. The Unit Mariner, as it is known, is Diesel powered and rated at 30 tons capacity at a 12 foot radius. Base length of the boom is 45 feet, which can be extended to 75 feet.

Yugoslavia Steps Up Exploration

Yugoslavia has intensified exploration, especially in the province of Croatia. Seven oil fields are presently in operation in Croatia: Gojlo, Mramor-Brdo, Sumecani, Kriz, Klostar Ivanic, Dugo Selo and the oldest Yugoslav oil field, Selnica-Peklenica.

Exploratory drilling is being conducted along the Moslavina mountains and in the territory between the rivers Sava and Drava in the direction from Zagreb toward the east as far as Nova Gradiska.

Drilling is presently being carried out at Resnik, Vrbovac, Dubranec, Osekovo, Navska, Nova Gradiska and Janja Lipa. Sixteen modern rotary drilling rigs, including two American "Cardwell" rigs of 11,483 ft. capacity are in operation.

Geophysical work done in 1955 in these regions is now being continued with seismic parties in operations.

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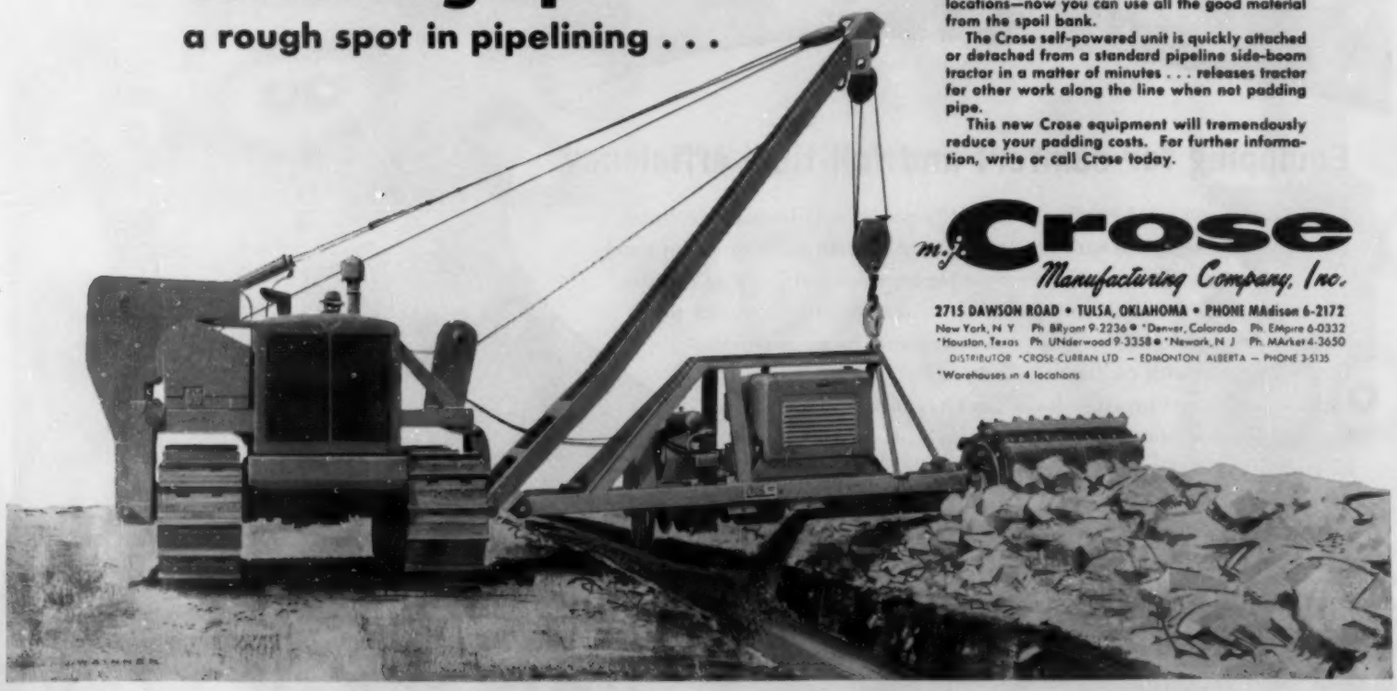

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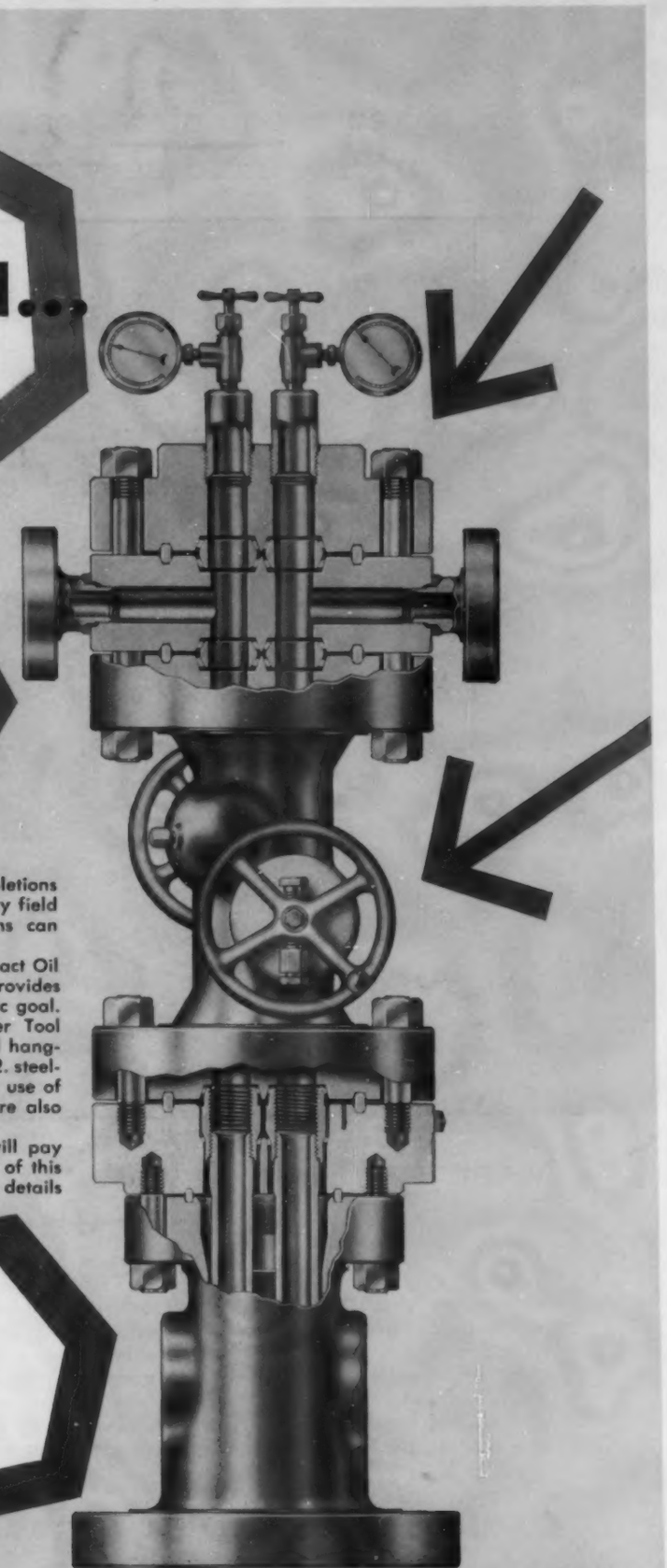

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